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AN AEROLOGICAL SURVEY OF THE UNITED STATES

PART II. RESULTS OF OBSERVATIONS BY MEANS OF PILOT BALLOONS

By Willis Ray Gregg, Meteorologist

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PREFACE

The primary purpose of this "survey" is to give the results of observations of upper winds in such a way as to provide means for quickly and conveniently determining the influence that those winds will have on regular flight schedules along any airways that may be established east of the Rocky Mountains. To this end the data are presented in a series of tables and graphs, the former containing information in considerable detail and the latter giving a general picture of the more outstanding features. Discussion for the most part is designed merely to bring out clearly the facts shown in the tables and graphs.

Aside from their practical usefulness in connection with aviation, the data furnish information of great interest and value, both practical and theoretical in the study of many other problems. It is purposed to take up some of these from time to time in separate papers.

Only those who have worked with data of this sort can appreciate the great amount of pure drudgery involved in computing, classifying, and summarizing. Special acknowledgment is due Mr. William C. Haines, in charge of the pilot balloon section of the Aerological Division, who superintended this work, and who in addition offered helpful suggestions in connection with the study. Grateful appreciation is also expressed to Messrs. L. A. Stevens, W. P. Long, R. E. Frushour, and N. W. Haas for the patience, accuracy, and fidelity with which they carried on the tedious work of compiling and reducing the data.

AN AEROLOGICAL SURVEY OF THE UNITED STATES

PART II. RESULTS OF OBSERVATIONS BY MEANS OF PILOT BALLOONS

By Willis Ray Gregg, Meteorologist

INTRODUCTION

Part I of this "survey" containing the "Results of observations by means of kites," was published in 1922 as Supplement No. 20; W. B. 768 (*1*). Among other features charts were presented, showing the seasonal and annual distribution of the principal meteorological elements at various levels up to 4 kilometers for all parts of the United States east of the Rocky Mountains. Part II gives the results of observations with pilot balloons and is therefore limited to a discussion of wind direction and velocity only. On the other hand data are available for greater heights than can be reached with kites, and in addition certain conditions of weather that are unfavorable for the use of the latter, e. g., calms and very light winds, are represented in a summary of pilot balloon data. Unfortunately it has thus far been impossible to secure free-air data west of the Great Plains States, except at Denver and San Francisco and at a few additional places along the Pacific coast. These stations are too widely scattered for the purposes of this summary, viz., to give a general picture of free-air conditions over wide areas, and are therefore not included. Later it is hoped to cover this western region and in the meantime individual summaries for Denver and San Francisco will probably be given.

Part II, like its predecessor, is largely statistical in character and is designed, so far as this can be done at present, to meet the needs of aviation for information regarding flying conditions in different parts of the country. In addition it is believed that the facts presented will contribute materially to our general knowledge of the characteristics of the free atmosphere.

THE DATA—SOURCES AND GEOGRAPHIC CLASSIFICATION

During the World War numerous pilot-balloon stations were established by the Weather Bureau and by the newly organized meteorological services in the War and Navy Departments. Some of these stations were abandoned shortly after the close of the war, though many have been continued and several new ones have been added. Owing to the shortness of some of the records and more particularly, in order to avoid an unwieldy multiplicity of tables and illustrations, it has seemed advisable to consider the data in classes or groups, each group including a region all parts of which are similar with respect to topography and general meteorological conditions. Figure 1 shows the areas included in these groups, and Table 1 gives the names of the observing stations, together with their locations and altitudes above sea level.

Table 1.—*Pilot-balloon stations in each group, service under which each operated, and their geographical coordinates*

Station	Service	Latitude N.	Longitude W.	Altitude M. S. L.
		° ′	° ′	*m.*
GROUP 1				
Ellendale, N. Dak	U. S. W. B	45 59	98 34	444
Fort Omaha, Nebr	U. S. A	41 15	95 55	350
Drexel, Nebr	U. S. W. B	41 33	96 27	396
Mean				397
GROUP 2				
Burlington, Vt	U. S. W. B	44 29	73 13	132
Ithaca, N. Y	U. S. W. B	42 26	76 34	291
Lansing, Mich	U. S. W. B	42 45	84 38	263
Madison, Wis	U. S. W. B	43 03	89 18	307
Mean				248
GROUP 3				
McCook Field, Ohio	U. S. A	39 47	84 12	226
Park Field, Tenn	U. S. A	35 34	89 52	83
Royal Center, Ind	U. S. W. B	40 53	86 29	225
West Point, Ky	U. S. A	37 50	86 00	232
Wilbur Wright Field, Ohio	U. S. A	39 49	84 02	254
Mean				204
GROUP 4				
Aberdeen P. G., Md	U. S. A	39 30	76 10	6
Camp Alfred Vail, N. J	U. S. A	40 20	74 03	7
Cape May, N. J	U. S. A	38 55	74 55	5
Bolling Field, D. C	U. S. A	38 54	77 03	1
Edgewood Arsenal, Md	U. S. A	39 30	76 10	18
Dahlgren, Va	U. S. N	38 20	77 02	8
Fort Hancock, N. J	U. S. A	40 28	74 00	2
Lakehurst, N. J	U. S. N	40 05	74 18	32
Do	U. S. A	40 02	74 20	30
Mineola, N. Y	U. S. A	40 45	73 38	32
Mitchell Field, N. Y	U. S. A	40 45	73 40	29
Rockaway, N. Y	U. S. N	40 33	73 54	0
Sandy Hook, N. J	U. S. A	40 27	74 00	5
Washington, D. C	U. S. W. B	38 53	77 03	34
Mean				15
GROUP 5				
Fort Bragg, N. C	U. S. A	35 09	78 55	101
Camp Jackson, S. C	U. S. A	34 00	80 58	83
Due West, S. C	U. S. W. B	34 21	82 22	217
Hampton Roads, Va	U. S. N	36 57	76 18	13
Fort Monroe, Va	U. S. A	37 00	76 20	15
Langley Field, Va	U. S. A	37 04	76 22	17
Lee Hall, Va	U. S. A	37 10	76 36	14
Parris Island, S. C	U. S. N	32 20	80 40	5
Mean				58

TABLE 1.—*Pilot-balloon stations in each group, service under which each operated, and their geographical coordinates*—Continued

GROUP 6

Station	Service	Latitude N.	Longitude W.	Altitude M. S. L.
		° ′	° ′	m.
Fort Benning, Ga	U. S. A	32 22	84 57	104
Camp Greenleaf, Ga	U. S. A	35 04	85 14	260
Leesburg, Ga	U. S. W. B	31 47	84 14	85
Montgomery, Ala	U. S. A	32 21	86 23	49
Payne Field, Miss	U. S. A	33 40	88 32	82
Mean				116

GROUP 7

Daytona, Fla	U. S. A	29 18	81 00	7
Key West, Fla	U. S. W. B	24 33	81 48	11
Pensacola, Fla	U. S. N	30 21	87 16	4
Mean				7

GROUP 8

Broken Arrow, Okla	U. S. W. B	36 02	95 49	233
Fort Sill, Okla	U. S. A	34 40	98 20	108
Jefferson Barracks, Mo	U. S. A	38 29	90 19	151
Grove Field, Tex	U. S. A	32 51	96 48	142
Mean				158

GROUP 9

College Station, Tex	U. S. A	30 40	96 20	105
Ellington Field, Tex	U. S. A	29 36	95 10	20
Gerstner Field, La	U. S. A	30 07	93 06	5
Groesbeck, Tex	U. S. W. B	31 30	96 28	141
Kelly Field, Tex	U. S. A	29 25	98 31	211
Park Place, Tex	U. S. A	29 46	95 24	16
Mean				83

NOTE.—U. S. W. B. refers to U. S. Weather Bureau; U. S. A., to Meteorological Service of the U. S. War Department; and U. S. N., to Meteorological Service of the U. S. Navy Department.

NUMBER AND DISTRIBUTION OF OBSERVATIONS

As indicated in Table 2, the grouping together of observations makes available a sufficient number in each season and in each group for an accurate and quite complete study of the data at all flying levels, i. e., from

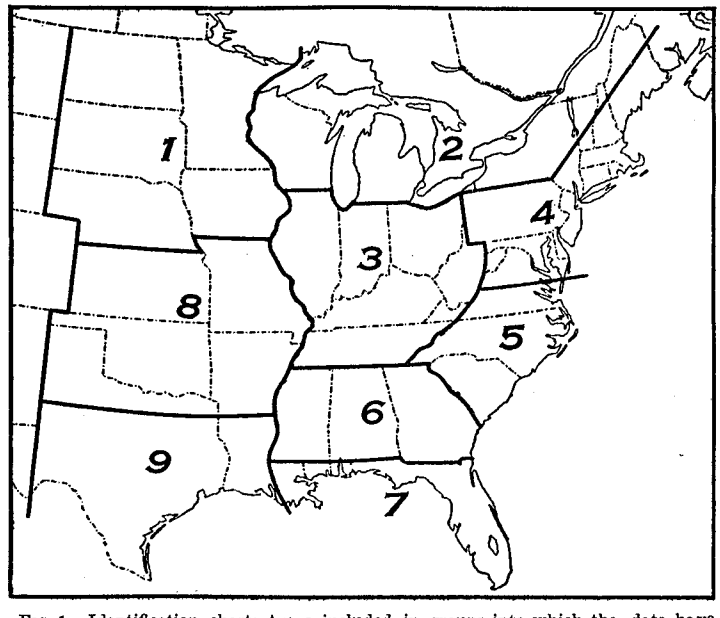

FIG. 1.—Identification chart: Areas included in groups into which the data have been divided

the surface up to 5 or 6 kilometers. Even at 8 and 10 kilometers the seasons in most cases are represented by 10 or more obervations. Considering all groups we have for discussion more than 30,000 individual observations in the lower levels, diminishing to about 19,000 at 2 kilometers and nearly 5,000 at 5 kilometers.

TABLE 2.—*Number of observations made at various levels*

GROUP 1

	Altitude, meters												
	Surface	250	500	750	1,000	1,500	2,000	3,000	4,000	5,000	6,000	8,000	10,000
Spring	771	771	771	722	671	557	439	278	171	99	65	20	11
Summer	623	623	623	610	582	464	382	248	170	106	74	28	12
Autumn	641	641	641	602	562	457	364	238	154	76	54	12	7
Winter	657	657	657	605	567	471	397	226	130	81	40	11	4
Annual	2,692	2,692	2,692	2,539	2,382	1,949	1,582	990	625	362	233	71	34

GROUP 2

Spring	1,088	1,086	1,087	1,040	981	834	702	475	311	207	142	61	12
Summer	945	934	937	920	897	828	711	513	374	258	178	94	36
Autumn	953	952	952	874	824	677	591	401	274	179	111	57	27
Winter	899	899	898	785	694	534	430	276	162	90	47	8	2
Annual	3,885	3,871	3,874	3,619	3,396	2,873	2,434	1,665	1,121	734	478	220	77

GROUP 3

Spring	1,030	1,029	1,030	948	868	717	573	382	224	122	79	34	19
Summer	488	486	486	470	460	423	373	264	189	132	96	49	22
Autumn	586	585	584	557	529	470	393	279	210	140	89	29	10
Winter	798	794	795	691	627	495	389	226	122	60	35	16	6
Annual	2,902	2,894	2,895	2,666	2,484	2,105	1,728	1,151	745	454	299	128	57

TABLE 2.—*Number of observations made at various levels*—Continued

	Altitude, meters												
	Surface	250	500	750	1,000	1,500	2,000	3,000	4,000	5,000	6,000	8,000	10,000
GROUP 4													
Spring	1,495	1,495	1,495	1,457	1,396	1,220	1,011	631	417	251	151	57	20
Summer	1,182	1,181	1,180	1,133	1,086	955	801	492	291	162	107	33	14
Autumn	1,408	1,406	1,406	1,346	1,299	1,119	970	669	430	235	140	38	16
Winter	1,579	1,576	1,578	1,522	1,440	1,167	916	487	238	92	52	13	4
Annual	5,664	5,658	5,659	5,458	5,221	4,461	3,698	2,279	1,376	740	450	141	54
GROUP 5													
Spring	1,525	1,525	1,525	1,384	1,288	1,065	851	529	337	183	99	39	15
Summer	868	868	868	787	758	656	553	357	245	136	88	31	13
Autumn	925	925	925	879	841	719	588	392	262	133	89	24	10
Winter	1,345	1,345	1,345	1,231	1,154	943	732	405	192	82	43	8	3
Annual	4,663	4,663	4,663	4,281	4,041	3,383	2,724	1,683	1,036	534	319	102	41
GROUP 6													
Spring	554	553	553	525	503	447	391	292	206	142	89	43	19
Summer	396	388	388	377	369	349	321	246	174	114	92	49	25
Autumn	465	461	461	445	434	403	372	307	246	171	137	57	33
Winter	638	638	638	592	563	506	459	340	244	126	72	24	7
Annual	2,053	2,040	2,040	1,939	1,869	1,705	1,543	1,185	870	553	390	173	84
GROUP 7													
Spring	429	429	429	389	370	294	228	140	105	60	29	11	1
Summer	355	355	355	330	308	258	164	90	56	39	33	13	6
Autumn	302	302	302	282	262	219	174	131	105	49	31	19	7
Winter	320	320	320	300	286	232	207	146	111	57	40	22	7
Annual	1,406	1,406	1,406	1,301	1,226	1,003	773	507	377	205	133	65	21
GROUP 8													
Spring	989	989	989	940	871	752	637	407	267	164	102	39	21
Summer	701	701	701	680	661	611	530	365	277	186	145	86	47
Autumn	710	710	710	665	644	554	486	334	233	167	122	52	19
Winter	908	908	908	856	809	741	628	445	289	159	94	36	15
Annual	3,308	3,308	3,308	3,141	2,985	2,658	2,281	1,551	1,066	676	463	213	102
GROUP 9													
Spring	1,090	1,090	1,090	984	909	760	623	447	311	197	111	50	24
Summer	762	762	762	709	664	576	491	356	258	149	101	50	29
Autumn	809	809	809	767	716	608	505	372	275	158	102	31	7
Winter	1,014	1,014	1,014	937	876	757	651	468	336	182	95	18	5
Annual	3,675	3,675	3,675	3,397	3,165	2,701	2,270	1,643	1,180	686	409	149	65
TOTALS													
Spring	8,971	8,967	8,969	8,389	7,857	6,646	5,455	3,581	2,349	1,425	867	354	142
Summer	6,320	6,298	6,300	6,016	5,785	5,120	4,326	2,931	2,034	1,282	914	433	204
Autumn	6,799	6,791	6,790	6,417	6,111	5,226	4,443	3,123	2,189	1,308	875	319	136
Winter	8,158	8,151	8,153	7,519	7,016	5,846	4,809	3,019	1,824	929	518	156	53
Annual	30,248	30,207	30,212	28,341	26,769	22,838	19,033	12,654	8,396	4,944	3,174	1,262	535

RELIABILITY OF THE DATA

So much has been written establishing the general accuracy of pilot balloon observations and the extent to which conclusions based upon them are trustworthy as indices of the average state of the atmosphere, so far as air movement is concerned, that only a brief summary will be given here. The chief factors to be considered are: (1) Equipment and methods of observation; (2) seasonal and diurnal distribution of the observations; and (3) distribution of the observations with respect to weather conditions.

1. *Equipment and methods of observation.*—Inasmuch as the observations are made by three different organizations, viz., the Weather Bureau and the meteorological services of the War and Navy Departments, it was recognized from the beginning that, so far as possible, standard equipment and uniform practice should be adopted. To this end the same general instructions for carrying on the work, with some minor exceptions as to unimportant details, have been followed by all three services (*2*),[1] and the same specifications have governed the purchase of theodolites and balloons. In all cases hydrogen has been produced by the electrolytic method with a purity of 99+ per cent. The original records

[1] These instructions were prepared during the World War; they were subsequently revised and expanded, and published under the title, "Instructions for Aerological Observers," W. B. 740. 1921.

have been sent in to the central office of the Weather Bureau for final reduction and study. Thus, the necessity of coordinating data obtained by different methods, with its attendant probability of more or less serious errors, has been avoided.

Many of the observations were made with two theodolites and from them was developed an empirical formula giving the relation between the rate of ascent of the balloon and its buoyancy or free lift, as follows:

$$V = 71\left(\frac{l^3}{L^2}\right)^{.208}$$

in which V is the rate of ascent in meters per minute, l, the free lift or ascensional force in grams, and L, the free lift plus the weight of the balloon.

This formula was used until 1921 when a revision was made as the result of further study based upon additional data, the revision consisting of a change in the constant from 71 to 72 and the introduction of small additive corrections during the first five minutes of ascent (*3*). The change in the constant involved a correction of only about 1 per cent, hardly worth considering, but the introduction of additive corrections during the first five minutes resulted in an appreciable difference in the accuracy of data from observations made before 1921 and those after that time, particularly in the lower levels. The earlier data used in this summary have therefore been corrected to conform with the present method of reduction, the corrections diminishing from 19 per cent at 250 meters to 10 per cent at 1,000, 2 per cent at 6,000, and 1 per cent at 10,000.

That the method of reduction now in use, viz, the revised formula and the additive corrections applied in the lowest levels, is dependable has been shown by Haines (*4*) in an analysis of numerous double-theodolite observations obtained since the revision was made, particularly at all altitudes with which we are here principally concerned, i. e., up to 6,000 meters. It was found that the average rate of ascent at these altitudes was for the most part within 0.5 to 2 per cent of the assumed rate. At greater heights there was a gradual increase in the rate of ascent, although data above 10,000 meters were too few to yield conclusive results on this point. We may therefore accept the average values as correct within 1 to 2 per cent.

2. *Seasonal and diurnal distribution of the observations.*—As indicated in Table 2, there is considerable variation in the number of observations for each season, particularly in groups 3 and 5, although each season is in all cases sufficiently represented. This inequality has been eliminated, for the annual values, by considering each season as a unit, i. e., the annual means have been computed from the seasonal means and not from the individual observations. Thus each season has been given the same weight. As regards the seasons, the observations are in general quite evenly distributed among the months composing them.

The diurnal distribution is less satisfactory than the seasonal, there being only two observations daily—in the early morning and the midafternoon. Fortunately, however, these hours, 6 to 8 a. m. and 2 to 4 p. m., are on the average approximately those of least and greatest diurnal wind velocity respectively at the surface. As will be shown later, there is near the surface a reversal of phase, with increased amplitude, but apparently the extremes at these levels, although in opposite phase, still occur at or very close to the hours of observation. Thus it appears that average values based upon these two observations represent quite closely actual average conditions such as would be shown if data were available for all hours of the day and night.

3. *Distribution of the observations with respect to weather conditions.*—Undoubtedly the most serious criticism that can be leveled against the pilot balloon as a means of upper-air exploration is that it is a "fair-weather" method and that only. Rain, snow, and fog, unless they be exceedingly light, are ruled out. Even low clouds limit observations to the strata below them. The matter is not as serious as at first appears, however. Not infrequently clouds are in more or less distinct masses, e. g., the cumulus and strato-cumulus types, between which the balloons are sent up, and in some cases the balloons are picked up after having been obscured by passing clouds. So far as rain, snow, and fog are concerned, it is true that balloons can not be seen in them, but it is also true that observations are frequently made shortly preceding or following their occurrence, the interval being too brief in many instances for any appreciable change to have taken place in wind conditions.

Kites are less subject to these limitations than are balloons, but on the other hand they can not be used in calms or very light winds. A comparison of results obtained by the two methods (*5*) shows that in the lower levels within well-developed anticyclones average wind velocities from kite records are slightly higher than are those from observations with balloons, owing to the frequency of very light winds. There appears to be no characteristic difference in the averages from the two methods in the lower levels within well-developed cyclones. In the upper levels of both anticyclones and cyclones averages from balloons are slightly higher than those from kites, probably because the latter are at times unable to surmount a stratum of comparatively quiet air above which strong winds, sometimes with a marked change in direction, prevail; partly also because at times the upper winds are themselves too strong for kite flying.

When the results under *all* conditions are compared, i. e., those dominated by anticyclones or cyclones and those with no well marked pressure distribution, it is found that kites and balloons give essentially the same average values in the lower levels and that balloons give slightly higher values in the upper levels, where kites at times can not be used. On the whole then it appears that the data under discussion in this summary can be accepted as representing very closely the average or normal state of the atmosphere in the eastern and central portions of the United States.

THE DATA PRESENTED

As already stated, the chief purpose of this summary is to present the results of upper air exploration with pilot balloons in such form as will best serve the needs of aviation. In order to fulfill this purpose it is necessary to give some of the data in considerable detail, e. g., the frequencies of different wind directions and speeds at flying levels; hence, some rather lengthy tables are included. However, as these tables contain information classified for several different sections of the country, a small part of them will usually suffice in a study of conditions along any one airway or in any one region. For those who are not vitally interested in the detailed data a more general picture is provided in the form of a number of graphs and charts. In examining either the tables or the figures reference should be made to Figure 1 for identification of the groups.

The data are discussed under the following headings:

1. Average free-air wind directions and velocities.
2. Diurnal variation in velocities.
3. Average free-air winds for different surface directions.
   (*a*) Turning of winds with altitude.
   (*b*) Change of velocity with altitude.
   (*c*) General summary.
4. Frequency of free-air winds from different directions.
5. Frequency of free-air winds of different velocities.
6. Free-air resultant winds.

1. *Average free-air wind directions and velocities.*—Table 3 gives these data for the four seasons and the year, at certain altitudes from the surface to 10 kilometers. In this as in later tables the altitude intervals selected are smaller near the surface than in the higher levels in order to show most detail in wind conditions where they are most irregular. Above 6 kilometers, as earlier stated, there are not enough observations for the determination of reliable means. Nevertheless, the values at 8 and 10 kilometers are included in this and three other tables in which the data are considered as a whole instead of being broken up into smaller units, and these values undoubtedly indicate at least the general tendencies. For example, in Table 3 a quite regular increase in wind velocity from 6 to 10 kilometers is shown in nearly all cases. The annual mean at 10 kilometers varies from somewhat more than 28 m. p. s. in the Northern States to about 24 in the Southern States, except in Florida where it is about 20. These values are consistent among themselves and are probably very close to true annual means.

The average directions given in this table have been computed from the observed directions without regard to their velocities, i. e., the directions have been considered as unit vectors. Similarly, the velocities are the arithmetic means of the individual observations, computed independently of the directions. *Resultant* winds, derived by the graphical method of compounding vectors, the length of each vector being the observed velocity, will be discussed in section 6. (See Tables 17 and 18.) In passing it may be remarked that directions computed by the two methods do not differ greatly but that the average velocities are higher than the resultants, owing to the considerable scatter in the directions. Particularly is this true in the lower levels where easterly winds occur nearly as frequently as westerly.

In Figure 2 are shown the average summer, winter and annual velocities from the surface to 6 kilometers. Although the annual values are based upon those of all four seasons, it is evident from the curves that they are also very closely the averages of summer and winter values, taken by themselves, especially at heights above about half a kilometer. At the surface the velocities are highest as a rule in spring, higher even than in winter, and those for autumn are practically the same as the annual. The result is that the annual curve in Figure 2 is closer at and near the surface to the one for winter than to that for summer instead of approximately midway between the two.

At all levels the spring averages are in general slightly higher than the annual, and the autumn values are slightly lower, owing to the tendency for winter conditions to continue into March and summer conditions into September and to a less extent October, i. e., the seasonal lag. From Table 3 it appears that this tendency is most pronounced in the higher levels, 3 kilometers and above, at southern stations, Groups 5 to 9. In the lower levels at these stations and at all heights in the Northern States, Groups 1 to 4, the difference between spring and autumn averages is of the order of 1 or 2 m. p. s. only.

In addition to the points above discussed, the following may be noted as characteristic features of free-air wind velocities in this country: (*a*) A marked increase from the surface to the level of gradient winds, about 500 meters; (*b*) little change, often a decrease, from that level to about 1,500 meters; and (*c*) a gradual increase from the latter to the base of the stratosphere.

The increase from the surface to the gradient wind level is of the order of 100 per cent, i. e., on the average the velocity at 500 meters is about double that at the surface. In individual cases it is frequently very much greater than this, particularly at night and in winter. On the other hand, in the middle of the day, when convection is active, and in summer, when horizontal temperature gradients are weak, the increase is slight, though usually present in some degree.

Velocities in the region between 500 and 1,500 meters, approximately, are exceedingly irregular. There is frequently a decrease, more or less pronounced, to a minimum near the 1 kilometer level. Such decrease occurs when there is a marked change in wind direction with height; also, along the border line between an anticyclone and a cyclone (*6*). On the other hand, if horizontal pressure and temperature gradients at the surface are in the same direction and strong, or even if the temperature gradient is strong and there is no well-marked pressure gradient at the surface, the wind velocity usually increases above 500 meters, though less markedly than below that level. This latter condition occurs most frequently in winter; in fact predominates then to the extent that the rate of increase between 500 and 1,500 meters is on the average about the same as at higher levels. In summer and to a less extent in spring and autumn, pressure and temperature gradients are frequently ill defined, with resulting irregularities in the winds at moderate levels. Even in these seasons, however, there are occasions when the velocity increases considerably with altitude. The average of all conditions then is one of little change with altitude at these levels at northern stations and a small decrease at southern. The curves show a quite regular rate of change with altitude between about 500 and 1,500 meters owing to the smoothing which results from averaging numerous individual observations in which the changes usually are abrupt and often are large and occur at slightly different altitudes from day to day. It seems likely, that, as stated by Humphreys (*6*) "the general average, if over a long period, approaches the type of change of velocity with height that would obtain normally if there were no cyclonic, anticyclonic, or other disturbances, except turbulence, in the flow of the air, while the great majority of individual observations show each the effects of some one or more disturbances of this nature."

Above 1,500 meters there is in general a fairly steady increase in velocity with height in conformity with the poleward temperature gradient that prevails at those levels. At southern stations, Groups 6 to 9, this increase is very small in summer owing to the frequency with which stagnant conditions of pressure and temperature prevail. Not infrequently the observations show practically no wind at all heights reached.

TABLE 3.—*Average free air winds m. p. s., in different parts of the United States*

(Figures in direction columns represent degrees)

GROUP 1

Altitude meters	Spring		Summer		Autumn		Winter		Annual	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Surface	S. 38 E.	6.5	S. 21 E.	5.2	S. 73 W.	5.8	N. 74 W.	6.2	S. 29 W.	5.9
250	S. 10 E.	9.9	S. 16 E.	8.7	S. 75 W.	9.8	N. 66 W.	10.0	S. 42 W.	9.5
500	S. 52 W.	10.7	S. 7 W.	9.3	S. 86 W.	10.8	N. 62 W.	11.7	S. 67 W.	10.6
750	S. 72 W.	10.9	S. 30 W.	9.3	N. 89 W.	11.0	N. 61 W.	12.5	S. 78 W.	11.0
1,000	S. 80 W.	10.8	S. 46 W.	9.2	N. 84 W.	11.1	N. 66 W.	13.2	S. 84 W.	11.1
1,500	S. 85 W.	10.7	S. 81 W.	9.2	N. 82 W.	11.4	N. 66 W.	13.9	N. 85 W.	11.3
2,000	N. 84 W.	11.4	N. 78 W.	9.8	N. 83 W.	12.2	N. 69 W.	15.3	N. 78 W.	12.2
3,000	N. 76 W.	13.5	N. 65 W.	11.2	N. 84 W.	15.1	N. 68 W.	17.6	N. 73 W.	14.4
4,000	N. 71 W.	15.8	N. 55 W.	12.8	N. 77 W.	17.6	N. 69 W.	20.6	N. 68 W.	16.7
5,000	N. 67 W.	18.5	N. 61 W.	14.3	N. 70 W.	19.6	N. 83 W.	23.6	N. 70 W.	19.0
6,000	N. 70 W.	20.6	N. 63 W.	15.5	N. 62 W.	21.1	N. 69 W.	25.4	N. 66 W.	20.6
8,000	N. 70 W.	23.2	N. 55 W.	19.5	N. 64 W.	23.6	N. 55 W.	26.3	N. 61 W.	23.2
10,000	N. 75 W.	28.3	N. 44 W.	25.5	N. 47 W.	26.6	N. 20 W.	26.1	N. 46 W.	26.6

GROUP 2

Surface	S. 68 W.	5.1	S. 74 W.	3.2	S. 53 W.	3.9	S. 72 W.	4.5	S. 67 W.	4.2
250	S. 70 W.	9.2	S. 80 W.	6.5	S. 72 W.	8.6	S. 79 W.	8.8	S. 75 W.	8.3
500	S. 81 W.	10.4	S. 82 W.	7.2	S. 82 W.	9.7	S. 89 W.	10.4	S. 84 W.	9.4
750	S. 86 W.	10.5	N. 86 W.	7.4	S. 85 W.	10.1	N. 89 W.	10.9	S. 89 W.	9.7
1,000	S. 87 W.	10.8	N. 84 W.	7.7	S. 87 W.	10.6	N. 85 W.	11.6	N. 89 W.	10.1
1,500	N. 86 W.	11.7	N. 81 W.	8.4	S. 88 W.	11.6	N. 79 W.	12.9	N. 85 W.	11.1
2,000	N. 77 W.	12.7	N. 73 W.	9.1	N. 84 W.	12.7	N. 77 W.	14.7	N. 78 W.	12.3
3,000	N. 66 W.	14.7	N. 66 W.	10.5	N. 79 W.	15.3	N. 71 W.	18.6	N. 70 W.	14.8
4,000	N. 61 W.	16.6	N. 66 W.	11.8	N. 76 W.	17.3	N. 68 W.	22.0	N. 68 W.	16.9
5,000	N. 57 W.	18.6	N. 64 W.	13.7	N. 70 W.	19.5	N. 62 W.	25.4	N. 63 W.	19.4
6,000	N. 60 W.	20.2	N. 66 W.	14.5	N. 69 W.	20.8	N. 64 W.	28.8	N. 64 W.	21.0
8,000	N. 54 W.	23.5	N. 63 W.	18.0	N. 54 W.	25.8	N. 67 W.	38.2	N. 56 W.	26.3
10,000	N. 46 W.	27.1	N. 31 W.	21.3	N. 51 W.	29.6	N. 67 W.	44.1	N. 42 W.	30.6

GROUP 3

Surface	S. 43 W.	4.8	S. 57 W.	3.5	S. 35 W.	3.9	S. 52 W.	4.6	S. 46 W.	4.2
250	S. 54 W.	8.7	S. 83 W.	6.2	S. 55 W.	7.6	S. 74 W.	8.8	S. 66 W.	7.9
500	S. 65 W.	9.9	W.	6.8	S. 64 W.	8.6	S. 75 W.	10.4	S. 74 W.	9.0
750	S. 74 W.	10.1	N. 84 W.	6.8	S. 74 W.	9.0	S. 88 W.	11.1	S. 83 W.	9.2
1,000	S. 81 W.	10.2	N. 76 W.	7.0	S. 81 W.	9.1	N. 87 W.	12.1	W.	9.7
1,500	N. 89 W.	11.1	N. 75 W.	7.5	S. 86 W.	10.0	N. 79 W.	13.6	N. 84 W.	10.6
2,000	N. 79 W.	12.4	N. 72 W.	8.0	S. 89 W.	11.2	N. 81 W.	15.2	N. 81 W.	11.8
3,000	N. 71 W.	14.8	N. 63 W.	8.9	N. 89 W.	12.8	N. 76 W.	18.4	N. 75 W.	13.7
4,000	N. 65 W.	16.9	N. 59 W.	10.0	N. 86 W.	14.8	N. 71 W.	21.5	N. 70 W.	15.8
5,000	N. 65 W.	19.0	N. 67 W	11.4	N 86 W.	16.9	N. 69 W.	24.4	N. 72 W.	17.9
6,000	N. 61 W.	20.1	N. 72 W.	12.6	N. 76 W.	18.7	N. 63 W.	26.6	N. 68 W.	19.5
8,000	N. 64 W.	21.7	N. 76 W.	15.9	N. 28 W.	22.4	N. 74 W.	34.2	N. 58 W.	23.9
10,000	N. 54 W.	26.5	N. 69 W.	20.0	N. 22 W.	24.6	N. 56 W.	42.5	N. 50 W.	28.4

GROUP 4

Surface	S. 80 W.	4.9	S. 63 W.	3.8	N. 68 W.	4.4	N. 69 W.	4.9	N. 88 W.	4.5
250	N. 89 W.	8.0	S. 88 W.	6.3	N. 65 W.	7.7	N. 71 W.	8.7	N. 80 W.	7.6
500	N. 80 W.	9.3	N. 82 W.	7.2	N. 63 W.	8.9	N. 61 W.	10.5	N. 72 W.	9.0
750	N. 73 W.	9.7	N. 78 W.	7.3	N. 60 W.	9.1	N. 65 W.	11.4	N. 69 W.	9.4
1,000	N. 68 W.	10.1	N. 75 W.	7.5	N. 62 W.	9.5	N. 66 W.	12.3	N. 68 W.	9.9
1,500	N. 67 W.	10.9	N. 62 W.	8.0	N. 65 W.	10.2	N. 68 W.	13.9	N. 66 W.	10.7
2,000	N. 66 W.	12.2	N. 56 W.	8.8	N. 63 W.	11.3	N. 69 W.	16.1	N. 64 W.	12.1
3,000	N. 68 W	14.2	N. 50 W.	10.6	N. 64 W.	14.0	N. 72 W.	20.5	N. 64 W.	14.9
4,000	N. 66 W	16.2	N. 64 W.	11.7	N. 63 W.	16.0	N. 70 W.	23.7	N. 66 W.	16.9
5,000	N. 59 W.	18.1	N. 71 W.	12.9	N. 53 W.	17.7	N. 72 W.	27.2	N. 64 W.	19.0
6,000	N. 53 W.	19.7	N. 80 W.	13.9	N. 52 W.	19.4	N. 71 W.	30.8	N. 64 W.	20.9
8,000	N. 51 W.	23.6	N. 54 W.	16.3	N. 55 W.	22.0	N. 78 W.	36.5	N. 60 W.	24.6
10,000	N. 66 W.	26.6	N. 80 W.	19.4	N. 59 W.	25.6	N. 68 W.	42.6	N. 68 W.	28.6

GROUP 5

Surface	S. 35 W.	5.0	S. 25 W.	4.1	N. 20 W.	4.6	N. 77 W.	4.5	S. 76 W.	4.6
250	S. 62 W.	8.6	S. 49 W.	6.9	N. 16 W.	7.7	N. 67 W.	8.7	N. 86 W.	8.0
500	S. 80 W.	9.7	S. 69 W.	7.7	N. 23 W.	8.6	N. 70 W.	10.2	N. 77 W.	9.1
750	N. 88 W.	9.9	S. 83 W.	7.6	N. 59 W.	8.4	N. 73 W.	10.8	N. 79 W.	9.2
1,000	N. 88 W.	9.9	W.	7.6	N. 56 W.	8.5	N. 74 W.	11.4	N. 77 W.	9.4
1,500	N. 78 W.	10.3	N. 57 W.	7.7	N. 58 W.	9.1	N. 78 W.	13.4	N. 68 W.	10.2
2,000	N. 77 W.	11.4	N. 68 W.	8.4	N. 66 W.	10.2	N. 80 W.	15.5	N. 73 W.	11.3
3,000	N. 76 W.	13.8	N. 71 W.	9.5	N. 62 W.	12.3	N. 80 W.	19.6	N. 72 W.	13.7
4,000	N. 72 W.	15.9	N. 70 W.	10.6	N. 66 W.	13.9	N. 75 W.	23.2	N. 71 W.	15.9
5,000	N. 69 W.	17.5	N. 73 W.	11.4	N. 65 W.	15.6	N. 76 W.	26.5	N. 71 W.	17.7
6,000	N. 63 W.	18.8	N. 78 W.	12.0	N. 68 W.	17.3	N. 72 W.	28.8	N. 70 W.	19.2
8,000	N. 68 W.	23.4	N. 73 W.	14.5	N. 56 W.	22.5	N. 55 W.	31.8	N. 63 W.	23.1
10,000	N. 83 W.	25.8	N. 77 W.	19.5	N. 58 W.	28.6	N. 19 W.	32.9	N. 59 W.	26.7

TABLE 3.—*Average free air winds m. p. s., in different parts of the United States*—Continued

GROUP 6

Altitude meters	Spring		Summer		Autumn		Winter		Annual	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Surface	N. 13 W.	4.0	S. 30 W.	2.5	N. 43 E.	2.7	N. 64 W.	3.6	N. 37 W.	3.2
250	S. 53 W.	7.0	S. 71 W.	5.0	N. 8 E.	6.1	N. 65 W.	7.0	N. 80 W.	6.3
500	S. 47 W.	8.2	S. 69 W.	5.8	N. 24 E.	6.7	N. 79 W.	8.4	N. 89 W.	7.2
750	S. 51 W.	8.4	S. 70 W.	5.9	N. 26 E.	6.7	N. 77 W.	9.2	N. 86 W.	7.6
1,000	N. 80 W.	8.7	S. 71 W.	6.2	N. 17 E.	7.6	N. 72 W.	9.9	N. 67 W.	7.9
1,500	N. 76 W.	9.5	S. 73 W.	6.6	N. 10 W.	7.2	N. 70 W.	11.1	N. 68 W.	8.6
2,000	N. 73 W.	10.6	S. 86 W.	6.7	N. 58 W.	8.0	N. 77 W.	12.5	N. 76 W.	9.4
3,000	N. 74 W.	12.9	N. 80 W.	6.7	N. 68 W.	9.4	N. 78 W.	15.5	N. 75 W.	11.1
4,000	N. 67 W.	15.1	N. 70 W.	6.8	N. 65 W.	10.5	N. 80 W.	18.2	N. 70 W.	12.7
5,000	N. 67 W.	17.5	N. 46 W.	7.1	N. 65 W.	11.8	N. 78 W.	21.9	N. 64 W.	14.6
6,000	N. 70 W.	19.2	N. 55 W.	6.7	N. 64 W.	12.9	N. 79 W.	24.4	N. 67 W.	15.8
8,000	N. 69 W.	24.2	N. 16 W.	8.5	N. 49 W.	16.6	N. 88 W.	32.8	N. 56 W.	20.5
10,000	N. 52 W.	27.2	N. 20 W.	11.4	N. 50 W.	20.2	N. 68 W.	37.6	N. 48 W.	24.1

GROUP 7

Surface	S. 55 E.	5.9	S. 36 E.	5.1	N. 65 E.	5.3	N. 48 E.	5.6	S. 85 E.	5.5
250	S. 63 E.	8.2	S. 38 E.	6.5	N. 74 E.	7.9	N. 75 E.	8.9	S. 79 E.	7.9
500	S. 59 E.	8.4	S. 26 E.	6.8	N. 82 E.	8.3	S. 69 E.	9.4	S. 58 E.	8.3
750	S. 62 E.	8.1	S. 28 E.	6.4	N. 81 E.	7.5	S. 62 E.	9.2	S. 62 E.	7.8
1,000	S. 60 E.	7.7	S. 27 E.	6.4	N. 74 E.	7.3	S. 11 E.	8.9	S. 50 E.	7.6
1,500	S. 76 E.	8.1	S. 22 E.	6.0	N. 73 E.	6.5	S. 27 W.	8.9	S. 46 E.	7.2
2,000	S. 77 E.	7.9	S. 37 E.	5.8	N. 68 E.	6.3	S. 76 W.	9.4	S. 60 E.	7.3
3,000	N. 76 W.	8.3	S. 57 E.	5.7	N. 86 E.	7.0	S. 63 W.	11.0	S. 2 W.	8.0
4,000	N. 64 W.	9.4	S. 20 E.	6.2	S. 66 W.	7.6	S. 74 W.	12.5	S. 62 W.	8.9
5,000	N. 59 W.	10.8	N. 81 E.	6.6	N. 85 W.	8.8	S. 83 W.	14.7	N. 69 W.	10.2
6,000	N. 62 W.	12.8	S. 80 E.	6.6	N. 62 W.	9.5	S. 78 W.	17.7	N. 73 W.	11.6
8,000	N. 80 W.	18.4	N. 78 E.	6.9	N. 20 W.	11.2	N. 87 W.	24.2	N. 45 W.	15.2
10,000	W.	23.0	N. 67 E.	11.9	N. 40 W.	15.5	N. 63 W.	32.3	N. 46 W.	20.7

GROUP 8

Surface	S. 10 E.	5.7	S. 18 E.	4.2	S. 20 E.	4.9	S. 60 W.	5.5	S. 4 W.	5.1
250	S. 4 W.	10.0	S. 2 W.	7.9	S. 4 W.	9.5	S. 76 W.	9.3	S. 22 W.	9.2
500	S. 12 W.	11.3	S. 3 W.	9.0	S. 40 W.	10.9	S. 82 W.	10.8	S. 34 W.	10.5
750	S. 33 W.	11.2	S. 11 W.	8.4	S. 37 W.	10.8	N. 89 W.	11.4	S. 42 W.	10.4
1,000	S. 47 W.	10.9	S. 14 W.	7.8	S. 51 W.	10.3	N. 86 W.	11.9	S. 51 W.	10.2
1,500	S. 71 W.	11.0	S. 28 W.	6.8	S. 73 W.	9.9	N. 83 W.	12.5	S. 68 W.	10.1
2,000	S. 79 W.	11.7	S. 61 W.	6.5	S. 87 W.	10.2	N. 83 W.	13.5	S. 80 W.	10.5
3,000	W.	13.7	S. 86 W.	6.9	S. 88 W.	10.9	N. 79 W.	16.4	N. 89 W.	12.0
4,000	N. 79 W.	15.7	N. 50 W.	7.3	N. 83 W.	12.3	N. 77 W.	18.8	N. 72 W.	13.5
5,000	N. 80 W.	17.5	N. 38 W.	7.7	N. 69 W.	13.7	N. 69 W.	20.7	N. 64 W.	14.9
6,000	N. 84 W.	20.1	N. 47 W.	8.5	N. 61 W.	15.3	N. 62 W.	22.8	N. 64 W.	16.7
8,000	N. 68 W.	23.8	N. 42 W.	11.3	N. 26 W.	18.8	N. 43 W.	26.5	N. 45 W.	20.1
10,000	N. 48 W.	29.2	N. 33 W.	14.0	N. 34 W.	23.1	N. 62 W.	29.7	N. 44 W.	24.0

GROUP 9

Surface	S. 49 E.	5.0	N. 68 W.	3.9	S. 82 E.	4.5	N. 68 W.	4.8	S. 88 W.	4.6
250	S. 40 E.	8.1	N. 74 W.	6.1	S. 65 E.	8.0	S. 74 W.	8.0	S. 12 W.	7.5
500	S. 33 E.	8.7	N. 70 W.	6.4	S. 65 E.	8.4	S. 70 W.	8.9	S. 19 W.	8.0
750	S. 27 E.	8.7	N. 84 W.	6.2	S. 60 E.	8.4	S. 84 W.	9.3	S. 26 W.	8.2
1,000	S. 13 E.	8.7	N. 89 W.	5.8	S. 53 E.	8.4	N. 89 W.	9.8	S. 32 W.	8.1
1,500	S. 48 W.	8.8	N. 85 W.	5.5	S. 53 E.	8.5	N. 85 W.	10.4	S. 60 W.	8.3
2,000	S. 80 W.	9.7	S. 86 W.	5.5	S. 83 W.	8.8	S. 86 W.	11.3	S. 84 W.	8.8
3,000	S. 88 W.	11.5	N. 82 W.	5.7	N. 76 W.	10.2	N. 82 W.	14.1	N. 83 W.	10.4
4,000	N. 83 W.	14.1	N. 78 W.	6.4	N. 71 W.	11.1	N. 78 W.	16.7	N. 77 W.	12.1
5,000	N. 78 W.	16.6	N. 69 W.	7.1	N. 75 W.	13.1	N. 69 W.	19.1	N. 73 W.	14.0
6,000	N. 76 W.	18.3	N. 59 W.	8.0	N. 66 W.	14.5	N. 59 W.	20.9	N. 65 W.	15.4
8,000	N. 68 W.	23.2	N. 27 W.	10.0	N. 47 W.	17.2	N. 27 W.	27.4	N. 42 W.	19.5
10,000	N. 81 W.	27.7	N. 34 W.	11.4	N. 44 W.	19.5	N. 34 W.	35.0	N. 48 W.	23.5

2. *Diurnal variation in velocities.*—It has long been well known that winds at the surface are on the average strongest in the afternoon and weakest in the early morning. It is not so well known, but should be clearly recognized, that the daily march in the free air is the exact opposite of this. Fortunately, the hours of pilot balloon observations are very close to those at which the lowest and highest velocities occur at the surface and presumably also at upper levels, and the data therefore in all likelihood give the range very satisfactorily, but not the character of the change, i. e., the "diurnal march," between the extremes. These data are presented in Table 4 for all four seasons and the year, and in Figure 3 for summer, winter, and the year only. The records of individual stations were used for this purpose, since the a. m. and p. m. data had already been tabulated separately, thus making the computation of the mean a simple matter, whereas in the study by geographic groups the data were arranged by surface directions without regard to time of day, and a rearrangement later would have entailed a large amount of tedious labor. The groups are represented very satisfactorily by the stations here selected, as follows: Groups 1 and 2, Ellendale and Drexel; Group 3, Royal Center; Group 4, Washington; Groups 5 and 6, Due West; Group 7, Key West; Group 8, Broken Arrow; and Group 9, Groesbeck.

An inspection of the values in Table 4 confirms several of the points brought out in the discussion of Table 3 and Figure 2, including (*a*) the higher velocities at and near the surface in spring than in any other season; (*b*) the close agreement among the spring, autumn and annual values, except near the surface; and (*c*) the small change from 500 to 1,500 and 2,000 meters.

In Figure 3 it is shown also that velocities in the morning increase sharply from the surface to about the 500-meter level, but that no such increase occurs in the curves for the afternoon. The difference in the two sets of curves is striking and should serve as a warning against accepting results from only one observation daily as representative of average conditions.

The diurnal range at the surface is approximately 1 to 2 m. p. s. The change of phase occurs between 50 and

100 meters. Above this level there is a rapid increase in the range to about 500 meters where it amounts to 2 to 4 m. p. s., except that at Key West it is only about 1 m. p. s. The diurnal variation practically ceases at 1,500 to 2,000 meters, the height of no change being apparently somewhat higher in summer than in winter. There does not seem to be any marked seasonal variation in the range at about 500 meters; nor is there any variation that can be attributed to latitude alone. There is, however, a somewhat greater range at those stations where the diurnal temperature range is large and therefore convection is active, e. g., Drexel, Broken Arrow and Groesbeck. On the other hand, at Key West, far removed from any extended land areas and relatively free therefore from appreciable convectional activity, the range both at the surface and above is very small, and ceases altogether at about 1,400 meters. Moreover, near the surface the change with altitude in the afternoon is similar to that in the morning, though less pronounced, whereas at the other stations, the character of the a. m. and p. m. curves is distinctly different.

In general, the results here presented are similar to those found elsewhere (*7*) (*8*). For example, C. L. Ray in a recent report gives the following figures for Lansing, Mich., and Madison, Wis., plus sign indicating an increase from a. m. to p. m. and minus sign a decrease:

LANSING, MICH.

	Surface	250	500	750	1,000	1,500	2,000
Spring	+1.4	0	−1.2	−0.8	−0.7	−0.5	−0.4
Summer	+1.5	−1.0	−1.5	−1.3	−1.2	−1.2	−0.9
Autumn	+1.2	−1.2	−1.5	−1.1	−1.2	−0.3	−0.3
Winter	+0.7	−1.7	−1.0	+0.3	0	−0.2	−0.5
Annual	+1.3	−0.9	−1.3	−0.8	−0.8	−0.6	−0.5

MADISON, WIS.

Annual	+0.5	−2.0	−1.9	−1.6	−1.4	−1.6	−1.6

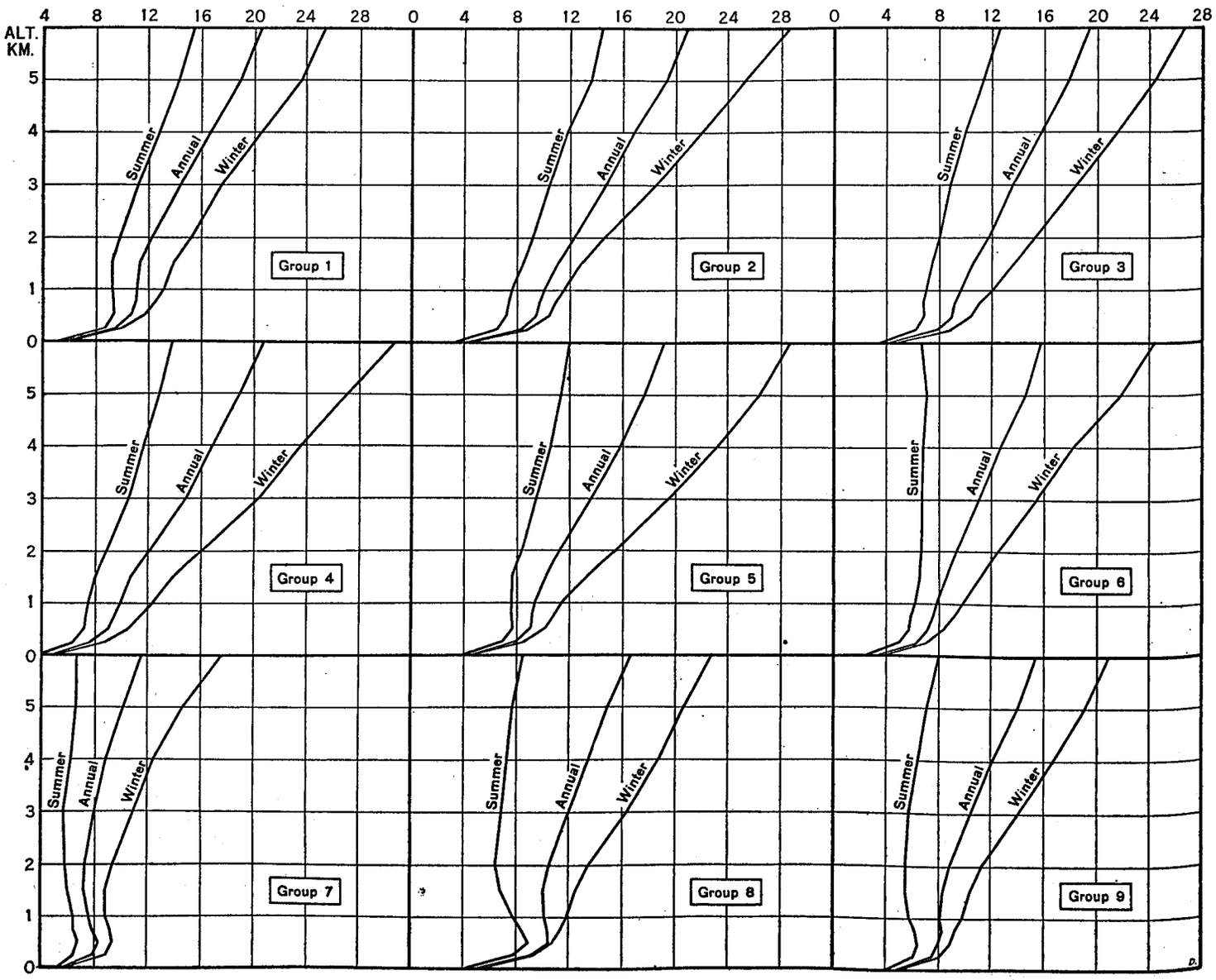

FIG. 2.—Average summer, winter, and annual free-air wind velocities, m. p. s., in eastern and central United States

The results thus far discussed are based upon *all* observations irrespective of wind direction. In a study of the upper winds of Oklahoma, Riley (*9*) has found that there is a pronounced diurnal variation with winds of all directions, but that the greatest range occurs with the strongest winds. It seems likely that this relation with wind velocities is characteristic of all parts of the country.

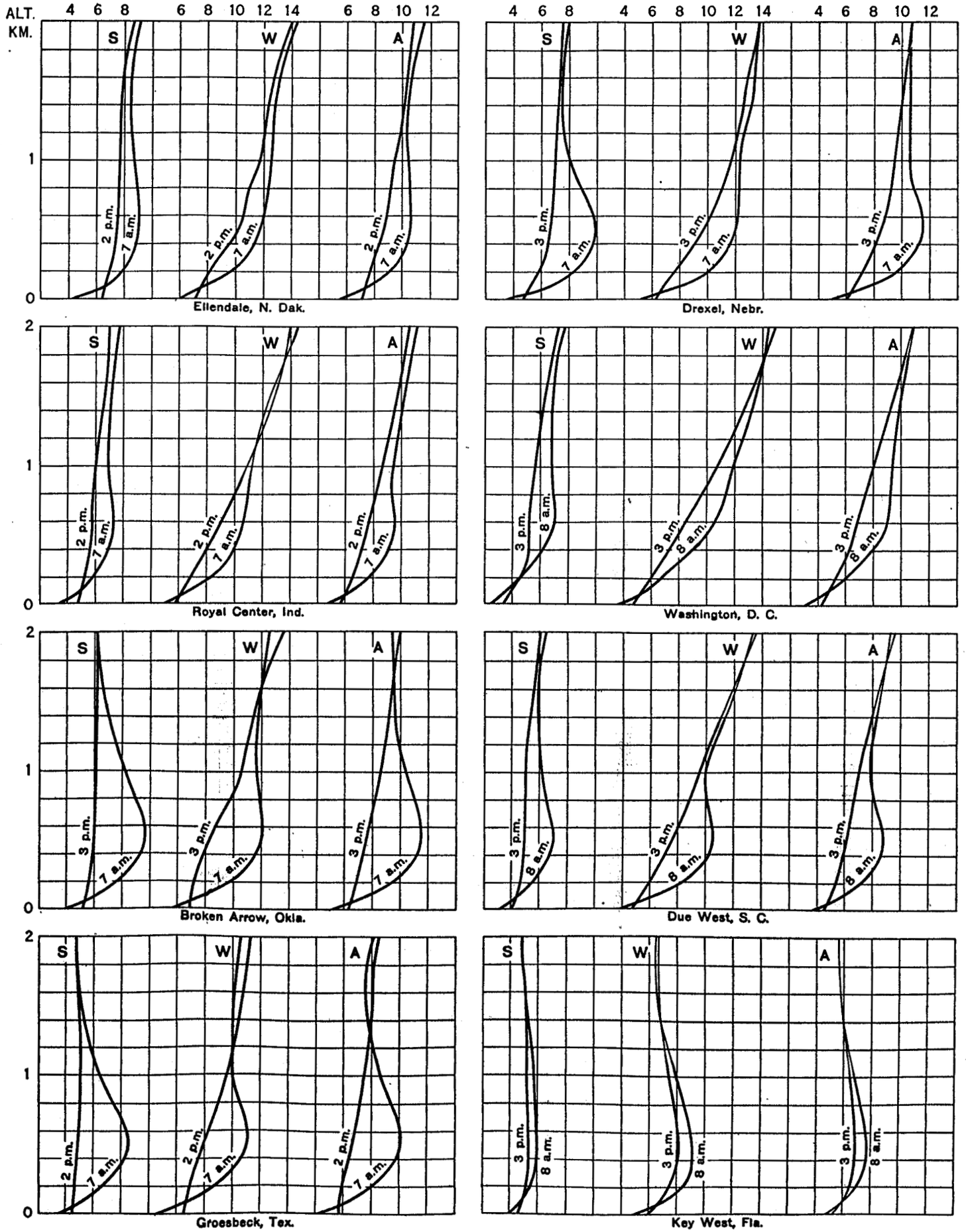

FIG. 3.—Average a. m. and p. m. wind velocities at selected stations. S=summer, W=winter, and A=annual

TABLE 4.—*Average free-air wind speeds, m. p. s., in early morning and mid-afternoon at selected stations*

BROKEN ARROW, OKLA.

	Surface	Altitude, meters						Surface	Altitude, meters					
		250	500	750	1,000	1,500	2,000		250	500	750	1,000	1,500	2,000
	7 a. m.							3 p. m.						
Spring	6.1	10.8	12.5	12.3	11.3	10.5	10.2	7.4	7.9	8.6	9.0	9.7	10.0	10.4
Summer	3.9	8.2	9.6	9.1	8.2	6.7	6.1	5.1	5.7	5.9	6.0	6.0	6.1	6.1
Autumn	4.7	10.2	11.7	11.0	10.0	9.0	8.7	6.2	6.7	7.1	7.8	8.1	8.9	9.1
Winter	5.6	10.2	11.9	11.9	11.6	11.8	12.5	6.7	7.2	8.1	9.4	10.5	11.6	13.4
Annual	5.1	9.8	11.4	11.1	10.3	9.5	9.4	6.3	6.9	7.4	8.0	8.6	9.2	9.8

DREXEL, NEBR.

	7 a. m.							3 p. m.						
Spring	5.0	10.3	11.9	11.2	10.7	10.2	9.9	7.3	8.5	9.1	9.5	9.5	10.0	10.8
Summer	3.5	8.8	9.9	9.1	8.2	7.5	7.8	4.6	6.1	6.5	6.9	7.0	7.3	7.5
Autumn	4.3	10.2	11.7	11.5	11.3	11.2	11.0	5.6	7.0	8.1	8.9	9.5	10.2	10.5
Winter	4.9	10.4	12.0	12.2	12.3	13.2	13.6	6.0	7.9	9.6	10.8	11.7	12.6	13.6
Annual	4.4	9.9	11.4	11.0	10.6	10.5	10.6	5.8	7.4	8.3	9.0	9.4	10.0	10.6

DUE WEST, S. C.

	8 a. m.							3 p. m.						
Spring	3.6	7.4	9.0	8.5	8.1	8.6	9.5	4.9	6.1	6.7	7.2	7.8	9.0	10.0
Summer	3.1	5.9	7.0	6.6	6.2	5.9	6.3	3.9	4.8	4.9	5.0	5.0	5.4	6.0
Autumn	3.3	7.6	8.3	7.6	7.0	7.1	8.1	3.8	4.8	5.3	5.6	5.9	7.0	8.1
Winter	3.7	9.0	10.5	10.2	9.9	11.7	13.2	4.6	6.3	7.4	8.6	9.5	11.4	13.4
Annual	3.4	7.5	8.7	8.2	7.8	8.4	9.3	4.3	5.5	6.1	6.6	7.0	8.2	9.4

ELLENDALE, N. DAK.

	7 a. m.							2 p. m.						
Spring	5.8	9.4	10.2	10.0	9.8	9.8	10.3	7.8	7.7	8.1	8.6	8.9	9.5	9.9
Summer	4.5	8.2	8.9	9.0	8.6	8.4	9.0	6.4	7.1	7.4	7.5	7.6	7.8	8.5
Autumn	5.3	10.4	11.5	11.2	11.1	11.0	12.0	7.1	7.9	8.8	9.3	9.3	10.0	10.5
Winter	6.0	10.2	11.7	12.2	12.5	12.9	14.2	7.1	8.5	10.2	10.8	11.8	12.5	13.8
Annual	5.4	9.5	10.6	10.6	10.5	10.5	11.4	7.1	7.8	8.6	9.1	9.4	10.0	10.7

GROESBECK, TEX.

	7 a. m.							2 p. m.						
Spring	4.7	9.0	11.0	10.8	9.9	8.8	9.4	6.8	7.0	7.6	7.9	8.5	8.9	9.3
Summer	3.4	7.1	8.4	7.7	6.5	5.2	4.7	4.4	4.7	4.8	5.0	5.0	4.9	4.7
Autumn	3.3	8.2	9.4	8.8	8.1	7.3	7.3	5.0	5.5	6.3	6.4	6.9	7.2	7.8
Winter	4.5	9.4	11.0	10.6	9.9	10.0	10.5	6.3	7.0	7.8	8.8	9.6	10.5	11.2
Annual	4.0	8.4	10.0	9.5	8.6	7.6	8.0	5.6	6.0	6.6	7.0	7.5	7.9	8.3

KEY WEST, FLA.

	8 a. m.							3 p. m.						
Spring	5.0	7.4	7.7	7.5	6.9	5.8	5.6	5.5	6.8	6.8	6.8	6.7	6.0	5.9
Summer	3.9	5.6	5.8	5.8	5.6	5.1	4.8	4.5	5.2	5.3	5.1	5.1	5.1	4.8
Autumn	4.7	7.3	7.5	7.0	6.3	5.6	5.3	5.0	6.7	7.0	6.9	6.5	6.0	5.3
Winter	4.7	8.7	9.0	8.5	7.9	6.7	6.4	5.6	7.5	8.0	7.8	7.4	6.7	6.3
Annual	4.6	7.2	7.5	7.2	6.7	5.8	5.5	5.1	6.6	6.8	6.6	6.4	5.9	5.6

ROYAL CENTER, IND.

	7 a. m.							2 p. m.						
Spring	5.1	9.0	10.6	10.5	10.2	10.5	11.3	6.7	7.7	8.4	8.5	9.0	10.2	10.4
Summer	3.2	6.1	7.3	7.2	7.0	7.2	7.7	4.6	5.4	5.7	5.8	6.0	6.7	7.1
Autumn	3.7	8.4	9.5	9.2	9.4	10.3	10.8	5.2	6.5	7.3	7.7	8.5	9.6	10.6
Winter	4.8	8.9	10.4	10.9	11.2	12.6	14.5	5.7	7.2	8.6	9.8	10.9	12.9	14.0
Annual	4.2	8.1	9.5	9.4	9.5	10.2	11.1	5.5	6.7	7.5	8.0	8.6	9.8	10.5

WASHINGTON, D. C.

	8 a. m.							3 p. m.						
Spring	3.4	6.5	8.8	9.5	9.6	10.3	11.0	4.8	6.1	7.1	7.6	8.2	9.7	11.1
Summer	2.2	5.0	6.6	6.9	6.8	6.9	7.6	3.3	4.7	5.2	5.3	5.6	6.4	7.2
Autumn	2.3	7.0	9.0	9.0	8.9	9.1	10.2	3.7	5.1	5.9	6.5	7.1	8.6	9.8
Winter	3.1	7.2	9.9	11.2	11.8	13.4	14.4	4.4	6.2	7.9	9.2	10.6	12.9	14.8
Annual	2.6	6.4	8.6	9.1	9.3	9.9	10.8	4.1	5.5	6.5	7.2	7.9	9.4	10.7

3. *Average free-air winds for different surface directions.*—It is well known that upper winds differ decidedly as to both direction and velocity, with wind direction at and very close to the earth's surface. This variation is fairly consistent, i. e., for a given surface direction the change in direction and velocity with altitude is similar from time to time, differences as a rule being those of degree rather than of kind. This is to be expected, since free-air winds are intimately related to pressure and temperature gradients which in turn are closely related to pressure distribution, and therefore to wind also, at or near the surface. Table 5 gives the relation between surface direction and free-air directions and velocities in considerably greater detail than has heretofore been possible. Summer, winter, and annual values are included for all nine groups up to 6 kilometers. As stated earlier, the annual values fit quite closely those for spring and autumn also; therefore, all parts of the year are represented. From the data in this table it is possible to find quickly, for any part of the country east of the Rocky Mountains, the characteristic behavior of winds above each of the 16 directions at the surface and above calms in all four seasons and for the year. A detailed examination of the data shows that the relation between free-air winds and surface directions is so nearly the same in different parts of the country as to justify a regrouping into larger geographic units, thus smoothing out irregularities in the higher levels, due to the small number of observations in some of the groups, and also rendering discussion less tedious than it would be if the nine groups in Table 5 were considered separately. This course has been followed, means being computed for Groups 1 to 4, Northern States, Groups 5 to 9, Southern States, and for all nine groups. The results will be considered under three headings: (*a*) Turning of winds with altitude; (*b*) change of velocity with altitude; and (*c*) general summary.

3 (*a*). *Turning of winds with altitude.*—In Tables 6 and 7 are given, respectively, the average frequency of clockwise and counterclockwise turning (known also as veering and backing *or* right-hand and left-hand turning) and the average amount of the turning or deviation. In part the data are shown also in Figures 4 and 5.

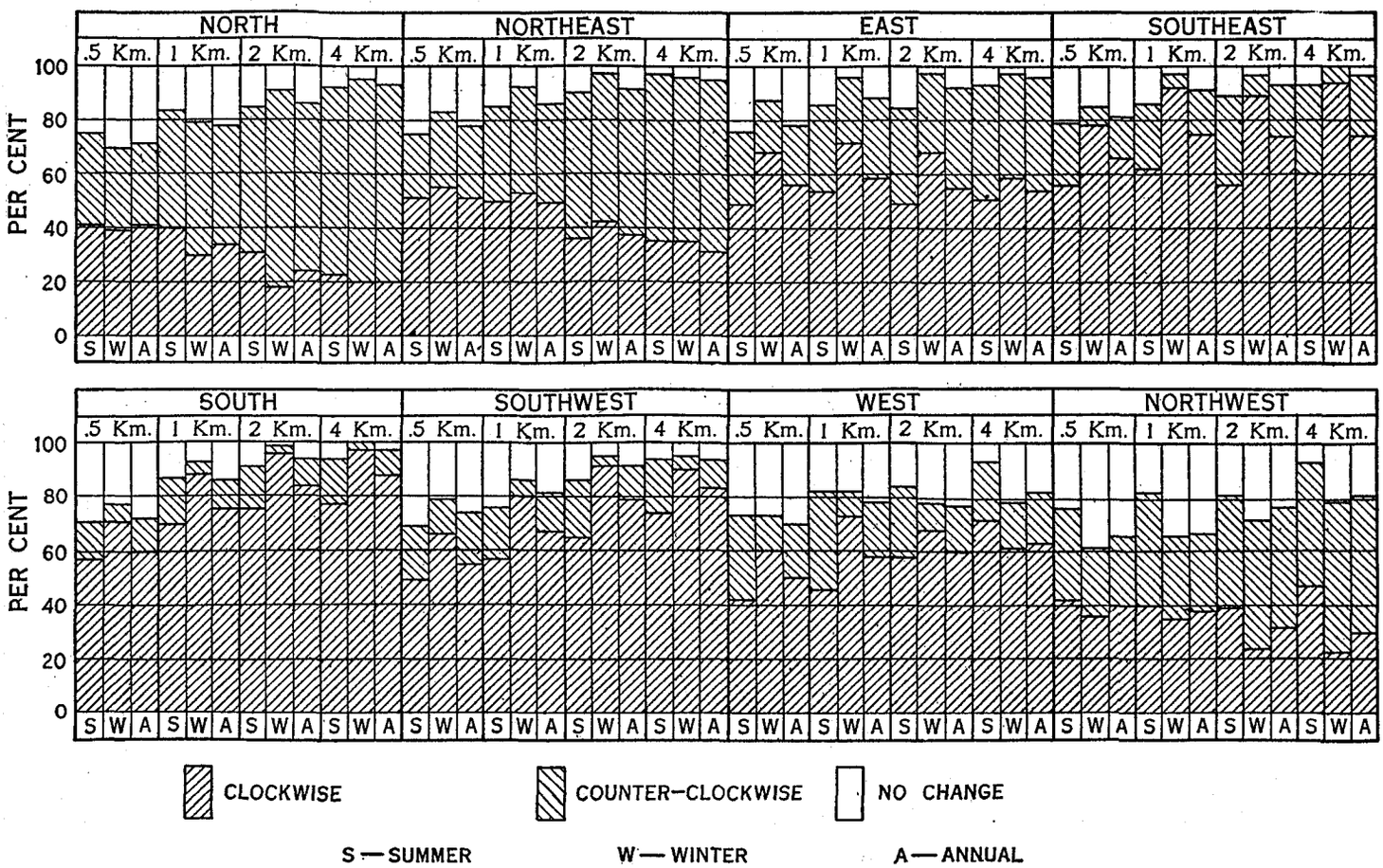

FIG. 4.—Average summer, winter, and annual percentage frequency of clockwise, counterclockwise, and no turning of winds with altitude from surface direction in eastern and central United States

A study of Table 6 and Figure 4 brings out the following as the more striking features, so far as the *frequency* of the two kinds of turning is concerned:

(1) Near the surface, clockwise turning is more frequent than counterclockwise with all directions; this difference is greatest with southerly winds, i. e., east to west-southwest.

(2) With increasing altitude the frequency of clockwise turning increases above southerly surface winds, decreases above northerly winds and changes little above east and west winds; the frequency of counterclockwise turning increases above northerly winds, i. e., west-northwest to east-northeast and shows little change above all other directions.

(3) There is a fairly large seasonal variation in the clockwise turning above southerly winds, most pronounced in the upper levels. Thus, at 4 kilometers for the country

as a whole, the clockwise turning above southeast to southwest winds averages from 90 to 95 per cent in winter, whereas in summer it is about 70 per cent. There seems to be little, if any seasonal variation in counterclockwise turning except above north and north-northwest winds. Here the frequency at 4 kilometers is about 85 in winter and about 70 in summer.

(4) The latitudinal variation is fairly pronounced in summer but slight in winter. For example, at 4 kilometers the clockwise turning above southeast to southwest winds in summer amounts to about 80 per cent at northern stations and 60 per cent at southern; in winter it averages between 90 and 95 in both regions. Counterclockwise turning above north and north-northwest winds occurs about 70 per cent of the time in summer at northern stations and 65 per cent at southern; in winter there is little difference, the average being about 85 per cent.

(5) The frequency of no turning from surface direction is greatest with northerly winds and diminishes with altitude for all directions, being negligible at 4 kilometers and higher.

(6) The last item in each section of Table 6 gives the mean turning for *all* directions. These figures show the decided preponderance of clockwise over counterclockwise turning near the surface, the ratio being about 2 to 1 in summer and 3 to 1 in winter; the decrease in those ratios as greater altitudes are reached; and the decrease with altitude in the frequency of winds which represent no change in direction from the surface.

The average *amount* of deviation from surface direction is given in Table 7, and for the year at all stations is shown also in Figure 5. The data may be summarized as follows:

(1) Near the surface the deviation is to the right on the average for all directions but is greatest with winds having a south component.

(2) Above 500 meters it increases with southerly winds, particularly with those from east-southeast to south-southeast. With northerly winds, on the other hand, the average deviation at these upper levels is to the left, more especially with north to northeast winds.

(3) The deviation with increasing altitude is in general roughly proportional to the angle between the surface direction and a westerly direction as is well shown in Figure 5.

(4) The tendencies above noted are more pronounced in the northern than in the southern part of the country and in winter than in summer, i. e., the turning is greatest when and where the latitudinal temperature gradient is strongest and therefore the prevailing westerlies best developed.

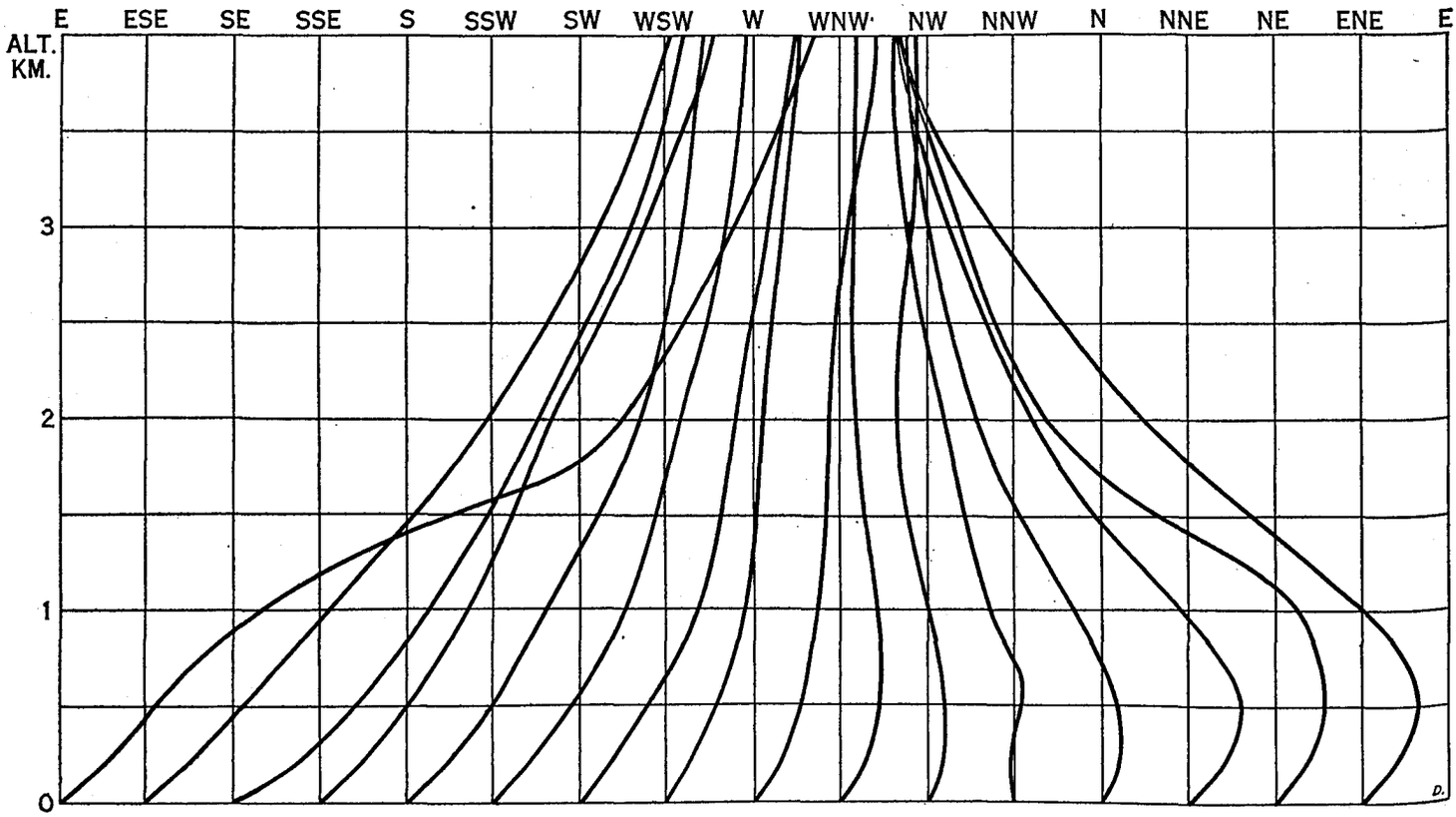

FIG. 5.—Average annual turning of winds with altitude in eastern and central United States

Taking a broad, general survey of the data presented in Tables 6 and 7 and Figures 4 and 5, we find that those surface directions from which there is the largest deviation with altitude are in general also those that have the largest percentage frequency of turning, either to the right or to the left. Thus, considering annual values, southerly winds show at 4 kilometers a large deviation to the right and a very high frequency of clockwise turning; northerly winds, a large, though less decided, deviation to the left and a fairly high frequency of counterclockwise turning. Near the surface there is a similar consistency. In other words, to quote Doctor Meisinger (*10*), "The greatest average deviation occurs with greatest reliability of turning; the least deviation occurs with the least reliability of turning."

It may be noted that in a few instances there is some discrepancy between the annual values and the average of those for summer and winter. As elsewhere stated, however, the annual values are based upon data for all four seasons. In general they do not lie quite midway between those for summer and winter, but incline slightly toward the former.

3 (*b*) *Change of velocity with altitude.*—A mere glance at Table 8 and Figure 6 will show that the different directions at the surface are associated with characteristic changes in velocity with altitude quite as definitely as with changes in direction. The principal features disclosed are:

(1) From the surface to about 500 meters there is a large increase with all directions; it is greatest with south to southwest winds and least with north-northeast to east winds.

(2) At higher levels lowest velocities are still found above easterly surface winds, particularly east-northeast and east; highest velocities, however, occur above west to northwest winds at 2 kilometers and higher instead of above south to southwest.

(3) There is a marked seasonal variation and a less pronounced but still appreciable variation with latitude, the explanation of this being of course the same as that previously given for the variation in deviation from surface direction, *viz.*, the strength of the latitudinal temperature gradient, both at the surface and in the higher levels. This statement applies to the values above easterly winds as well as to those above other directions. It should be borne in mind that easterly surface winds change as a rule to westerly in the higher levels, particularly in winter, and the velocities are of course associated with these westerly directions. In the few cases in which the easterly surface winds remain easterly with increasing altitude the velocities are as a rule comparatively low.

3 (*c*) *General summary.*—In Table 9 are given, as nearly as they can now be determined, the average directions and velocities above each of the 16 directions at the surface for the northern and southern sections of the country. These figures are based upon those in Tables 7 and 8. They can be accepted only as averages for fairly large areas. However, variations between individual places would in general be small, except at and near the surface where topography and other factors might play a fairly large part. The last line in each section of Tables 5 and 8 gives average values above calms at the surface. Naturally these are very irregular and in no sense characteristic. Therefore, they have not been included in the preparation of Table 9. The data presented show, in somewhat different form, the same general features that have already been discussed in connection with Tables 7 and 8 and Figures 4 and 5. These may be very briefly recapitulated as follows:

(1) Surface velocities differ little with season, latitude or direction.

(2) From the surface to about 500 meters winds of all directions usually veer and increase in velocity, these tendencies being most pronounced with southerly winds.

(3) At higher levels velocities continue to increase above westerly winds, but they decrease slightly above easterly winds, these changes being accompanied by continued veering above southerly winds, but by a backing above northerly winds, the result being a fairly close approach to a westerly direction, except that northeast to east surface winds are very irregular.

(4) The seasonal and latitudinal variation, small at the surface, increases decidedly with altitude, the highest velocities and the nearest approach to a westerly direction occurring when and where the poleward temperature gradient, and therefore pressure gradient also, is strongest.

TABLE 5.—*Average free-air winds, m. p. s., for different surface directions*

(Figures in direction columns represent degrees)

GROUP 1

SUMMER

Surface		Altitude, meters											
		250		500		1,000		2,000		4,000		6,000	
Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
N	4.9	N. 4 E.	7.1	N. 3 E.	7.6	N. 12 W.	8.1	N. 33 W.	10.5	N. 31 W.	14.9	N. 49 W.	16.0
NNE	6.1	N. 26 E.	7.4	N. 28 E.	7.9	N. 19 E.	8.5	N. 46 E.	9.9	N. 68 W.	13.5		
NE	4.4	N. 65 E.	7.5	N. 69 E.	7.7	N. 58 E.	7.8	N. 15 E.	9.3	N. 49 W.	11.5	N. 78 W.	17.1
ENE	5.0	N. 71 E.	6.9	N. 72 E.	6.4	N. 35 E.	5.9	N. 52 W.	7.9				
E	3.4	S. 64 E.	6.1	S. 52 E.	6.3	S. 55 E.	5.6	N. 50 E.	5.8	N. 21 W.	7.7		
ESE	4.6	S. 46 E.	6.7	S. 47 E.	7.5	S. 33 E.	6.5	S. 26 E.	7.3	N. 48 W.	7.5		
SE	4.7	S. 31 E.	8.7	S. 23 E.	9.0	S. 6 E.	8.4	S. 60 W.	7.5	N. 73 W.	11.3	N. 73 W.	15.1
SSE	6.3	S. 13 E.	9.8	S. 12 E.	10.8	S. 8 W.	9.9	S. 62 W.	8.3	N. 60 W.	9.9	N. 78 W.	13.0
S	6.2	S. 9 W.	10.6	S. 15 W.	11.8	S. 26 W.	11.7	S. 54 W.	11.3	N. 78 W.	11.7	N. 73 W.	13.4
SSW	4.8	S. 25 W.	8.8	S. 45 W.	9.9	S. 49 W.	10.0	S. 78 W.	8.7	N. 54 W.	12.7		
SW	4.7	S. 50 W.	9.0	S. 53 W.	9.3	S. 63 W.	9.0	S. 77 W.	7.9	N. 60 W.	11.3	N. 55 W.	12.1
WSW													
W	5.6	N. 80 W.	10.4	N. 73 W.	10.8	N. 67 W.	10.6	N. 66 W.	11.4				
WNW	5.5	N. 61 W.	9.3	N. 62 W.	9.9	N. 56 W.	9.9	N. 68 W.	11.3				
NW	5.1	N. 32 W.	8.9	N. 30 W.	9.2	N. 39 W.	9.4	N. 51 W.	12.3	N. 53 W.	15.2	N. 80 W.	19.5
NNW	6.7	N. 12 W.	9.5	N. 12 W.	10.2	N. 21 W.	10.6	N. 35 W.	11.9	N. 67 W.	15.2		
Calm	0.0	S. 16 W.	3.2	S. 2 E.	4.6	S. 59 E.	5.8	N. 15 W.	6.8				

WINTER

N	5.9	N. 2 W.	8.6	N. 1 W.	9.5	N. 8 W.	11.6	N. 48 W.	12.8	N. 86 W.	16.5	N. 46 W.	22.6
NNE	5.4	N. 38 E.	7.7	N. 34 E.	8.5	N. 6 W.	9.0	N. 33 W.	9.3	N. 77 W.	12.1		
NE	5.1	N. 52 E.	7.3	N. 65 E.	8.2	N. 37 E.	9.1	N. 64 W.	10.7				
ENE	6.0	E.	8.3	S. 80 E.	7.2	S. 45 W.	10.8	S. 68 W.	14.5				
E	4.9	S. 71 E.	7.6	S. 46 E.	9.0	S. 8 W.	9.0	S. 68 W.	11.7				
ESE	5.3	S. 38 E.	10.8	S. 15 E.	16.2	S.	15.1	S. 54 W.	11.4				
SE	4.7	S. 24 E.	9.5	S.	12.0	S. 26 W.	12.6	S. 67 W.	14.0				
SSE	5.9	S. 4 E.	9.2	S. 18 W.	10.9	S. 43 W.	11.1	S. 84 W.	14.9				
S	5.6	S. 19 W.	10.7	S. 35 W.	12.4	S. 59 W.	13.3	S. 75 W.	14.1	S. 88 W.	19.5		
SSW	5.4	S. 55 W.	9.4	S. 80 W.	11.3	N. 88 W.	11.7	N. 77 W.	13.6	W.	15.3		
SW	5.2	S. 66 W.	9.8	S. 81 W.	11.7	N. 84 W.	12.3	N. 75 W.	15.7	N. 67 W.	19.3	N. 68 W.	23.2
WSW	4.0	S. 87 W.	8.6	N. 89 W.	10.0	N. 65 W.	13.0	N. 60 W.	15.7				
W	6.0	N. 66 W.	10.1	N. 63 W.	12.3	N. 59 W.	14.3	N. 56 W.	15.2	N. 58 W.	23.0		
WNW	5.9	N. 60 W.	9.3	N. 56 W.	11.4	N. 57 W.	13.2	N. 59 W.	16.3	N. 61 W.	24.8		
NW	8.9	N. 37 W.	13.0	N. 34 W.	14.8	N. 36 W.	17.4	N. 51 W.	20.1	N. 51 W.	24.2	N. 61 W.	29.2
NNW	8.4	N. 27 W.	10.4	N. 11 W.	11.3	N. 32 W.	13.9	N. 48 W.	17.3	N. 59 W.	26.2		
Calm	0.0	S. 78 W.	4.2	S. 83 W.	5.9	N. 84 W.	8.7	N. 73 W.	12.5				

ANNUAL

N	5.8	N. 5 E.	8.4	N. 3 E.	9.2	N. 10 W.	9.8	N. 42 W.	11.5	N. 65 W.	16.9	N. 66 W.	18.8
NNE	5.2	N. 31 E.	7.0	N. 30 E.	7.7	N. 18 E.	7.5	N. 23 W.	9.3	N. 69 W.	12.4	N. 78 W.	20.7
NE	4.9	N. 56 E.	7.5	N. 63 E.	8.0	N. 64 E.	8.2	N. 37 W.	9.3	N. 54 W.	14.0	N. 69 W.	19.4
ENE	5.0	N. 80 E.	7.3	N. 85 E.	7.1	N. 76 E.	7.9	N. 65 W.	9.4	N. 76 W.	15.4	N. 74 W.	20.4
E	4.6	S. 70 E.	7.1	S. 57 E.	7.8	S. 39 E.	7.3	S. 81 W.	8.1	N. 64 W.	11.8	N. 72 W.	16.9
ESE	4.6	S. 44 E.	8.3	S. 37 E.	9.9	S. 16 E.	8.7	S. 62 W.	9.4	N. 68 W.	13.6	N. 49 W.	20.1
SE	4.8	S. 29 E.	9.0	S. 15 E.	10.4	S. 5 W.	10.2	S. 42 W.	10.6	N. 84 W.	13.4	N. 77 W.	17.3
SSE	6.4	S. 9 E.	9.8	S. 1 W.	10.9	S. 23 W.	11.2	S. 55 W.	12.2	N. 54 W.	16.9	N. 37 W.	20.7
S	6.3	S. 13 W.	11.4	S. 23 W.	13.0	S. 38 W.	13.0	S. 61 W.	12.2	N. 89 W.	14.9	N. 86 W.	18.8
SSW	6.3	S. 36 W.	10.7	S. 50 W.	11.7	S. 63 W.	12.2	S. 82 W.	12.4	N. 81 W.	16.1	N. 70 W.	17.5
SW	5.2	S. 54 W.	9.6	S. 63 W.	10.6	S. 78 W.	10.7	S. 88 W.	12.3	N. 75 W.	16.1	N. 64 W.	19.2
WSW	5.5	S. 75 W.	8.6	S. 80 W.	9.7	N. 87 W.	11.6	N. 76 W.	15.1	N. 70 W.	19.6	N. 68 W.	25.4
W	5.6	N. 78 W.	9.5	N. 74 W.	10.5	N. 64 W.	11.6	N. 64 W.	13.6	N. 52 W.	20.3	N. 40 W.	24.1
WNW	6.3	N. 61 W.	10.2	N. 58 W.	11.3	N. 58 W.	12.1	N. 62 W.	14.1	N. 64 W.	20.9	N. 76 W.	25.9
NW	7.2	N. 36 W.	11.0	N. 35 W.	12.1	N. 39 W.	13.1	N. 53 W.	15.3	N. 56 W.	20.6	N. 70 W.	25.3
NNW	7.8	N. 17 W.	10.2	N. 10 W.	11.0	N. 22 W.	11.9	N. 49 W.	13.0	N. 68 W.	19.2	N. 79 W.	21.0
Calm	0.0	S. 52 W.	5.5	S. 47 W.	5.8	N. 70 W.	7.7	N. 46 W.	8.7	N. 74 W.	13.7	N. 27 W.	16.2

TABLE 5.—*Average free-air winds, m. p. s., for different surface directions*—Continued

(Figures in direction columns represent degrees)

GROUP 2

SUMMER

Surface		Altitude, meters											
		250		500		1,000		2,000		4,000		6,000	
Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
N	2.5	N. 3 W.	5.2	N. 5 W.	5.8	N. 12 W.	6.6	N. 28 W.	8.3	N. 47 W.	10.9	N. 57 W.	14.0
NNE	3.4	N. 29 E.	6.1	N. 30 E.	6.6	N. 6 E.	6.7	N. 8 W.	7.7	N. 23 W.	10.1	N. 60 W.	15.2
NE	2.7	N. 41 E.	5.5	N. 45 E.	5.9	N. 18 E.	5.8	N. 3 E.	7.5	N. 50 W.	9.4	N. 60 W.	12.0
ENE	3.1	N. 75 E.	7.0	N. 75 E.	7.5	N. 72 E.	7.6	N. 73 E.	5.1	N. 28 W.	7.9	N. 70 W.	12.2
E	2.0	S. 85 E.	4.4	S. 68 E.	5.3	S. 7 E.	7.4	N. 69 W.	8.2	N. 81 W.	9.3	N. 83 W.	11.1
ESE	2.5	S. 63 E.	5.6	S. 58 E.	5.4	S. 35 E.	5.5	S. 10 W.	5.8	N. 23 W.	5.9	N. 13 E.	7.5
SE	3.5	S. 17 E.	6.5	S. 5 E.	7.6	S. 3 W.	7.0	S. 50 W.	7.2	S. 55 W.	8.4	S. 78 W.	11.3
SSE	2.3	S. 8 E.	6.2	S. 3 W.	7.4	S. 16 W.	6.2	S. 60 W.	7.8	N. 73 W.	9.6	N. 42 W.	12.1
S	3.9	S. 15 W.	7.5	S. 29 W.	8.2	S. 46 W.	7.9	S. 62 W.	8.7	S. 84 W.	12.0	N. 75 W.	15.3
SSW	3.9	S. 29 W.	8.6	S. 46 W.	8.9	S. 60 W.	8.8	S. 77 W.	10.3	S. 85 W.	13.4	S. 71 W.	15.1
SW	3.7	S. 55 W.	8.7	S. 61 W.	9.7	S. 81 W.	9.6	S. 83 W.	10.5	N. 78 W.	13.0	N. 84 W.	15.4
WSW	3.0	S. 78 W.	8.3	S. 85 W.	9.2	N. 89 W.	9.9	N. 82 W.	12.3	N. 64 W.	13.7	N. 57 W.	15.9
W	3.5	N. 88 W.	7.5	N. 82 W.	8.9	N. 84 W.	9.9	N. 80 W.	12.7	N. 69 W.	15.2	N. 73 W.	14.6
WNW	3.1	N. 67 W.	7.6	N. 67 W.	9.0	N. 67 W.	9.2	N. 51 W.	10.3	N. 50 W.	15.6	N. 59 W.	21.9
NW	3.6	N. 48 W.	6.9	N. 64 W.	7.5	N. 51 W.	9.1	N. 50 W.	11.4	N. 68 W.	15.7	N. 61 W.	17.2
NNW	3.1	N. 23 W.	6.0	N. 20 W.	6.7	N. 32 W.	7.7	N. 39 W.	9.6	N. 57 W.	13.1	N. 64 W.	14.5
Calm	0.0	S. 41 W.	3.6	S. 79 W.	4.4	N. 17 E.	5.2	N. 1 E.	6.2	N. 39 W.	9.5	N. 70 W.	11.4

WINTER

N	3.5	N. 1 E.	6.4	N. 1 W.	7.2	N. 25 W.	8.7	N. 58 W.	12.9	N. 56 W.	23.1		
NNE	3.8	N. 12 E.	7.3	N. 17 W.	8.3	N. 18 W.	8.7	N. 53 W.	12.0	N. 64 W.	19.1	N. 37 W.	25.7
NE	3.3	N. 36 E.	6.1	N. 23 E.	7.0	N. 22 E.	7.9	N. 50 W.	11.3	N. 39 W.	17.3		
ENE	3.1	N. 69 E.	5.4	N. 58 E.	6.4	N. 52 W.	8.6	N. 54 W.	9.8	W.	16.8		
E	2.9	S. 36 E.	5.1	S. 26 E.	6.3	S. 77 W.	6.4	N. 77 W.	10.3	N. 77 W.	18.3		
ESE	2.9	S. 48 E.	6.1	S. 7 E.	7.2	S. 52 W.	11.2	N. 84 W.	14.1				
SE	4.0	S. 9 E.	7.6	S. 21 W.	9.5	S. 41 W.	10.4	S. 77 W.	13.1	N. 81 W.	22.9		
SSE	5.4	S. 1 E.	10.5	S. 16 W.	12.4	S. 41 W.	14.0	S. 64 W.	15.6	N. 84 W.	22.6		
S	6.6	S. 11 W.	11.1	S. 31 W.	12.2	S. 62 W.	12.5	S. 76 W.	15.4	N. 84 W.	23.9		
SSW	3.9	S. 35 W.	9.9	S. 53 W.	11.5	S. 68 W.	13.2	S. 74 W.	15.1	N. 79 W.	19.5		
SW	3.9	S. 62 W.	10.1	S. 77 W.	12.4	S. 86 W.	15.6	N. 83 W.	18.8	N. 70 W.	25.5	N. 67 W.	28.2
WSW	4.1	S. 79 W.	9.8	S. 85 W.	12.2	N. 76 W.	13.2	N. 78 W.	17.0	N. 68 W.	25.3		
W	4.2	N. 80 W.	9.3	N. 73 W.	11.4	N. 67 W.	13.3	N. 68 W.	18.7	N. 72 W.	25.4		
WNW	5.4	N. 67 W.	10.1	N. 66 W.	11.8	N. 63 W.	13.4	N. 60 W.	17.3	N. 65 W.	26.3		
NW	4.9	N. 53 W.	9.0	N. 48 W.	10.6	N. 49 W.	12.0	N. 46 W.	14.5	N. 46 W.	20.1	N. 62 W.	26.2
NNW	4.2	N. 21 W.	7.9	N. 20 W.	8.7	N. 33 W.	15.4	N. 44 W.	17.7	N. 58 W.	23.6		
Calm	0.0	S. 58 E.	3.3	N. 78 W.	4.1	N. 72 W.	6.0	N. 65 W.	10.6	N. 63 W.	19.0		

ANNUAL

N	3.5	N. 5 W.	6.2	N. 7 W.	7.0	N. 18 W.	8.1	N. 33 W.	11.0	N. 36 W.	16.2	N. 44 W.	22.4
NNE	3.7	N. 21 E.	6.8	N. 15 E.	7.1	N. 11 W.	8.5	N. 35 W.	10.7	N. 46 W.	16.1	N. 65 W.	23.2
NE	3.2	N. 43 E.	6.4	N. 41 E.	7.1	N. 28 E.	7.3	N. 27 W.	8.9	N. 58 W.	12.7	N. 47 W.	16.7
ENE	3.2	N. 72 E.	6.5	N. 74 E.	7.2	N. 78 E.	7.8	N.	7.6	N. 41 W.	12.0	N. 41 W.	15.9
E	2.6	S. 69 E.	5.2	S. 72 E.	6.3	S. 62 W.	7.5	N. 48 W.	9.2	N. 63 W.	13.4	N. 63 W.	17.4
ESE	2.8	S. 58 E.	6.5	S. 38 E.	7.2	S. 4 E.	8.2	S. 33 W.	9.7	N. 75 W.	11.7	N. 48 W.	14.5
SE	4.1	S. 15 E.	7.7	S. 6 W.	9.4	S. 26 W.	9.6	S. 58 W.	10.7	S. 79 W.	15.1	N. 79 W.	18.9
SSE	4.3	S. 18 E.	9.2	S.	10.7	S. 33 W.	10.4	S. 62 W.	10.9	S. 87 W.	16.3	W.	20.0
S	5.6	S. 11 W.	9.8	S. 25 W.	11.0	S. 47 W.	11.3	S. 64 W.	12.9	S. 78 W.	17.6	W.	20.6
SSW	4.5	S. 29 W.	10.2	S. 45 W.	10.9	S. 60 W.	11.3	S. 74 W.	13.2	N. 84 W.	16.9	N. 67 W.	20.5
SW	4.1	S. 56 W.	9.5	S. 66 W.	11.3	S. 78 W.	12.4	S. 86 W.	14.4	N. 83 W.	18.7	N. 78 W.	22.6
WSW	3.8	S. 78 W.	9.5	S. 84 W.	11.2	S. 89 W.	11.7	N. 82 W.	14.7	N. 59 W.	18.6	N. 51 W.	21.0
W	4.0	N. 85 W.	8.6	N. 80 W.	10.1	N. 78 W.	11.7	N. 72 W.	16.0	N. 67 W.	20.8	N. 67 W.	22.8
WNW	4.4	N. 68 W.	9.0	N. 67 W.	10.5	N. 68 W.	11.7	N. 62 W.	14.7	N. 64 W.	21.3	N. 59 W.	28.2
NW	4.5	N. 48 W.	8.2	N. 51 W.	9.1	N. 51 W.	10.6	N. 48 W.	13.4	N. 55 W.	18.5	N. 62 W.	22.5
NNW	4.3	N. 25 W.	7.7	N. 23 W.	8.4	N. 30 W.	12.3	N. 40 W.	14.8	N. 50 W.	20.4	N. 57 W.	25.3
Calm	0.0	N. 46 W.	5.1	N. 52 W.	4.6	N. 16 W.	5.9	N. 27 W.	8.4	N. 57 W.	14.0	N. 58 W.	18.0

TABLE 5.—*Average free-air winds, m. p. s., for different surface directions*—Continued

(Figures in direction column represent degrees)

GROUP 3

SUMMER

Surface		Altitude, meters											
		250		500		1,000		2,000		4,000		6,000	
Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
N	4.7	N.	5.6	N. 2 E.	6.1	N. 5 E.	6.9	N. 32 W.	8.9	N. 46 W.	11.8	N. 56 W.	16.2
NNE	3.2	N. 30 E.	6.9	N. 26 E.	6.1	N. 18 E.	5.9	N. 3 W.	6.4	N. 39 W.	13.2		
NE	3.0	N. 48 E.	4.6	N. 46 E.	5.3	N. 44 E.	5.7	N. 15 E.	5.2	N. 43 W.	7.5	N. 73 W.	10.3
ENE	3.2	N. 79 E.	6.4	N. 78 E.	6.4	N. 46 E.	6.3	N. 68 E.	4.6	N. 47 W.	3.9		
E	3.7	N. 86 E.	5.5	N. 84 E.	6.0	N. 83 E.	6.3	N. 42 E.	6.5	N. 50 E.	7.4	N. 68 E.	9.0
ESE	3.8	S. 60 E.	6.5	S. 50 E.	5.5	S. 39 E.	3.4	S. 14 E.	2.7				
SE	3.0	S. 33 E.	5.0	S. 30 E.	5.1	S. 20 E.	4.8	S. 31 E.	5.8	N. 63 W.	7.6	N. 68 W.	9.1
SSE	3.3	S. 16 W.	4.3	S. 42 W.	4.6	S. 64 W.	6.9	N. 88 W.	12.9				
S	2.8	S. 15 W.	6.1	S. 22 W.	6.6	S. 19 W.	7.3	S. 62 W.	8.1	N. 71 W.	9.1	S. 73 W.	11.6
SSW	2.2	S. 28 W.	7.6	S. 39 W.	8.7	S. 53 W.	7.9	S. 64 W.	8.4	N. 82 W.	10.4	S. 68 W.	12.3
SW	4.2	S. 60 W.	8.1	S. 67 W.	9.1	S. 73 W.	9.4	S. 72 W.	10.0	S. 84 W.	11.7	S. 78 W.	15.6
WSW	4.0	S. 78 W.	8.1	S. 83 W.	9.5	S. 83 W.	9.8	N. 84 W.	9.6	N. 75 W.	11.3		
W	4.0	N. 81 W.	6.8	N. 80 W.	7.5	N. 79 W.	8.0	N. 67 W.	9.9	N. 49 W.	12.4	N. 71 W.	16.2
WNW	3.9	N. 63 W.	6.8	N. 63 W.	7.8	N. 63 W.	8.6	N. 61 W.	8.0	N. 52 W.	10.8	N. 45 W.	14.3
NW	3.6	N. 30 W.	5.1	N. 42 W.	5.4	N. 41 W.	5.7	N. 51 W.	9.4	N. 35 W.	12.5		
NNW	4.1	N. 18 W.	5.6	N. 22 W.	6.4	N. 47 W.	6.5	N. 58 W.	11.1				
Calm	0.0	N. 73 W.	3.1	N. 71 W.	3.8	N. 44 W.	4.3	N. 47 W.	4.9	N. 66 W.	7.2		

WINTER

N	3.6	N. 25 E.	7.1	N. 16 E.	7.7	N. 2 W.	9.0	N. 50 W.	12.0	N. 65 W.	21.9		
NNE	4.0	N. 33 E.	7.0	N. 38 E.	8.2	N. 27 E.	9.8	N. 25 W.	13.2				
NE	4.0	N. 59 E.	7.0	N. 66 E.	7.5	N. 42 E.	7.9	N. 61 W.	14.2	N. 48 W.	18.3	N. 66 W.	23.0
ENE	4.3	N. 74 E.	8.3	N. 88 E.	8.7	N. 79 E.	6.7	N. 66 W.	8.1	N. 51 W.	10.8		
E	4.1	S. 70 E.	7.1	S. 11 E.	7.8	S. 38 E.	6.9	N. 89 W.	9.2	N. 86 W.	17.2	N. 68 W.	21.9
ESE	4.2	S. 54 E.	7.1	S. 29 E.	8.5	S. 4 W.	13.0	S. 39 W.	14.4				
SE	3.9	S. 12 E.	5.7	S. 2 W.	7.4	S. 35 W.	8.8	S. 65 W.	10.7	S. 66 W.	14.8		
SSE	4.9	S. 6 W.	10.5	S. 19 W.	12.2	S. 38 W.	14.2	S. 70 W.	17.1				
S	4.5	S. 32 W.	11.1	S. 46 W.	13.5	S. 64 W.	14.6	S. 79 W.	16.6	N. 63 W.	23.2		
SSW	5.7	S. 46 W.	11.8	S. 57 W.	14.8	S. 72 W.	24.2	W.	27.0				
SW	5.2	S. 62 W.	10.1	S. 69 W.	12.4	S. 86 W.	15.4	N. 83 W.	18.5	N. 72 W.	24.7		
WSW	5.3	S. 73 W.	8.1	S. 80 W.	9.3	N. 78 W.	12.6	N. 76 W.	15.7				
W	5.7	N. 78 W.	9.4	N. 74 W.	10.9	N. 65 W.	13.5	N. 67 W.	18.9	N. 64 W.	26.2		
WNW	5.1	N. 62 W.	8.3	N. 62 W.	9.9	N. 57 W.	13.0	N. 68 W.	16.8				
NW	4.5	N. 41 W.	7.3	N. 39 W.	8.2	N. 38 W.	10.4	N. 51 W.	14.6	N. 62 W.	23.1		
NNW	4.2	N. 14 W.	7.1	N. 13 W.	7.2	N. 31 W.	9.5						
Calm	0.0	N. 68 W.	4.5	N. 87 W.	11.8	N. 89 W.	13.2	N. 62 W.	17.5				

ANNUAL

N	4.3	N. 7 E.	6.8	N. 5 E.	7.4	N. 2 E.	7.9	N. 28 W.	10.5	N. 46 W.	15.1	N. 46 W.	19.6
NNE	3.6	N. 34 E.	6.7	N. 37 E.	7.0	N. 15 E.	6.9	N. 22 W.	9.4	N. 32 W.	13.8	N. 31 W.	18.2
NE	3.4	N. 54 E.	5.4	N. 57 E.	5.9	N. 41 E.	5.9	N. 19 W.	8.4	N. 55 W.	12.3	N. 65 W.	17.0
ENE	3.5	N. 81 E.	7.3	N. 87 E.	7.6	N. 74 E.	7.0	N. 23 E.	6.3	N. 67 W.	8.8	N. 69 W.	14.2
E	3.8	S. 83 E.	6.4	S. 68 E.	6.9	S. 84 E.	6.5	N. 32 W.	7.8	N. 64 W.	11.8	N. 49 W.	16.0
ESE	3.6	S. 50 E.	7.1	S. 33 E.	7.4	S. 22 E.	7.4	S. 32 W.	7.9	N. 60 W.	14.4	S. 57 W.	19.5
SE	3.7	S. 24 E.	5.7	S. 11 E.	6.4	S. 10 W.	6.8	S. 30 W.	8.2	S. 87 W.	12.1	N. 74 W.	14.9
SSE	4.3	S. 2 W.	8.1	S. 15 W.	9.2	S. 33 W.	10.1	S. 63 W.	12.6	S. 87 W.	17.0	N. 84 W.	19.6
S	4.0	S. 22 W.	8.9	S. 32 W.	10.4	S. 42 W.	11.0	S. 63 W.	12.6	S. 83 W.	16.0	N. 73 W.	18.4
SSW	4.3	S. 40 W.	10.0	S. 44 W.	11.7	S. 56 W.	14.2	S. 70 W.	15.4	N. 89 W.	17.5	S. 86 W.	20.4
SW	4.8	S. 58 W.	9.5	S. 63 W.	11.2	S. 74 W.	14.6	S. 87 W.	14.1	N. 80 W.	18.0	N. 86 W.	21.5
WSW	5.2	S. 76 W.	8.7	S. 81 W.	10.1	N. 88 W.	11.6	N. 79 W.	14.0	N. 67 W.	19.0	N. 48 W.	17.5
W	5.2	N. 81 W.	7.9	N. 79 W.	9.0	N. 74 W.	10.3	N. 67 W.	14.2	N. 56 W.	19.0	N. 54 W.	24.2
WNW	5.0	N. 63 W.	8.2	N. 62 W.	9.4	N. 60 W.	10.8	N. 66 W.	13.4	N. 60 W.	21.2	N. 56 W.	26.2
NW	4.6	N. 38 W.	7.0	N. 42 W.	7.8	N. 39 W.	9.0	N. 54 W.	13.2	N. 53 W.	18.5	N. 58 W.	22.8
NNW	4.2	N. 22 W.	6.9	N. 17 W.	7.5	N. 28 W.	8.5	N. 46 W.	14.3	N. 50 W.	21.6	N. 34 W.	21.6
Calm	0.0	N. 86 W.	3.9	N. 85 W.	6.4	N. 77 W.	7.4	N. 60 W.	10.2	N. 81 W.	14.4	N. 41 W.	17.7

TABLE 5.—*Average free-air winds, m. p. s., for different surface directions*—Continued

(Figures in direction columns represent degrees)

GROUP 4

SUMMER

Surface		Altitude, meters											
		250		500		1,000		2,000		4,000		6,000	
Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
N	3.8	N. 10 E.	6.5	N. 13 E.	7.4	N. 6 E.	7.4	N. 16 W.	9.1	N. 15 W.	11.5	N. 57 W.	14.1
NNE	3.7	N. 29 E.	6.1	N. 33 E.	6.3	N. 21 E.	6.0	N. 12 W.	6.2	N. 60 W.	8.4		
NE	3.8	N. 47 E.	5.8	N. 47 E.	6.8	N. 42 E.	6.5	N. 4 E.	7.0	N. 43 W.	8.9	N. 82 W.	11.1
ENE	4.4	N. 69 E.	5.5	N. 67 E.	6.1	N. 63 E.	6.4	N. 35 E.	6.8	S. 11 W.	10.6		
E	4.7	N. 87 E.	6.0	N. 82 E.	6.4	N. 68 E.	6.3	N. 23 E.	6.9	S. 86 W.	8.3	S. 37 W.	9.3
ESE	3.5	S. 60 E.	5.0	S. 60 E.	5.2	S. 50 E.	5.9	S. 73 E.	6.3				
SE	4.1	S. 27 E.	5.0	S. 17 E.	5.3	S. 31 W	5.7	N. 61 W.	7.1	S. 63 W.	10.1	N. 59 W.	11.6
SSE	3.8	S. 3 W.	6.2	S. 10 W.	7.0	S. 25 W.	7.2	S. 27 W.	8.5				
S	3.9	S. 11 W.	6.0	S. 26 W.	6.7	S. 46 W.	7.4	S. 77 W.	8.4	N. 77 W.	11.1	N. 77 W.	14.3
SSW	4.1	S. 35 W.	6.5	S. 46 W.	7.8	S. 61 W.	7.8	S. 83 W.	8.9	N. 82 W.	12.5	N. 73 W.	13.9
SW	4.1	S. 53 W.	7.4	S. 62 W.	8.5	S. 73 W.	8.6	N. 83 W.	9.7	N. 58 W.	12.5	N. 42 W.	13.7
WSW	3.5	S. 83 W.	6.5	S. 86 W.	7.5	N. 89 W.	7.4	N. 84 W.	9.0	S. 89 W.	11.0		
W	3.6	N. 77 W.	7.0	N. 70 W.	8.3	N. 71 W.	8.7	N. 67 W.	9.8	N. 53 W.	13.9	N. 35 W.	15.2
WNW	4.1	N. 63 W.	6.9	N. 58 W.	8.4	N. 67 W.	8.9	N. 75 W.	10.2	N. 84 W.	15.3		
NW	4.3	N. 37 W.	7.1	N. 36 W.	8.0	N. 39 W.	8.7	N. 47 W.	10.4	N. 64 W.	13.9		
NNW	3.7	N. 22 W.	6.1	N. 21 W.	7.0	N. 29 W.	7.6	N. 45 W.	9.7	N. 62 W.	13.2	N. 73 W.	16.4
Calm	0.0	N. 75 W.	3.9	N. 62 W.	4.7	N. 51 W.	5.4	N. 46 W.	8.0	N. 46 W.	10.7		

WINTER

N	4.6	N. 6 E.	7.9	N. 2 E.	9.4	N. 11 W.	10.3	N. 30 W.	12.7	N. 56 W.	19.9	N. 73 W.	29.1
NNE	5.1	N. 26 E.	8.1	N. 32 E.	9.9	N. 23 E.	9.1	N. 31 W.	10.0	N. 74 W.	14.6		
NE	4.6	N. 56 E.	7.6	N. 64 E.	8.4	N. 76 E.	8.0	N. 55 W.	9.8	N. 43 W.	17.5	N. 73 W.	22.4
ENE	3.6	N. 80 E.	5.5	S. 82 E.	6.1	S. 37 W.	6.6	N. 84 W.	10.2	N. 89 W.	17.4		
E	2.9	S. 66 E.	6.1	S. 58 E.	7.2	S. 23 W.	7.7	N. 86 W.	10.8	N. 76 W.	17.8		
ESE	2.5	S. 70 E.	4.8	S. 48 E.	5.5	S. 17 W.	6.2	N. 81 W.	10.0				
SE	3.3	S. 7 E.	6.2	S. 21 W.	7.6	S. 42 W.	10.1	N. 81 W.	15.1				
SSE	3.3	S. 10 W.	6.8	S. 31 W.	9.1	S. 60 W.	11.7	S. 72 W.	15.6				
S	3.6	S. 24 W.	7.3	S. 40 W.	9.2	S. 62 W.	12.2	S. 77 W.	16.2	S. 85 W.	21.7		
SSW	4.2	S. 38 W.	8.0	S. 53 W.	10.1	S. 78 W.	12.3	W.	16.1	N. 68 W.	24.3		
SW	4.6	S. 66 W.	9.6	S. 77 W.	12.3	N. 88 W.	14.2	N. 85 W.	18.4	N. 85 W.	26.5		
WSW	4.8	S. 82 W.	10.0	S. 87 W.	12.5	N. 77 W.	15.2	N. 81 W.	19.6	N. 79 W.	26.3		
W	5.6	N. 78 W.	9.8	N. 73 W.	11.7	N. 67 W.	13.6	N. 75 W.	18.1	N. 73 W.	25.2	N. 59 W.	34.6
WNW	6.5	N. 56 W.	10.4	N. 57 W.	12.4	N. 54 W.	14.5	N. 62 W.	18.7	N. 77 W.	26.5		
NW	6.4	N. 46 W.	9.9	N. 45 W.	11.4	N. 48 W.	13.4	N. 57 W.	18.2	N. 65 W.	27.0	N. 64 W.	35.0
NNW	5.0	N. 23 W.	8.1	N. 23 W.	10.0	N. 32 W.	11.4	N. 59 W.	15.0	N. 72 W.	26.9		
Calm	0.0	S. 45 W.	4.4	S. 67 W.	6.2	S. 87 W.	8.5	N. 85 W.	11.5	N. 83 W.	20.0		

ANNUAL

N	4.4	N. 5 E.	7.4	N. 5 E.	8.5	N. 6 W.	8.8	N. 24 W.	10.8	N. 32 W.	16.1	N. 49 W.	21.0
NNE	4.0	N. 28 E.	6.4	N. 33 E.	7.2	N. 18 E.	7.2	N. 17 W.	9.0	N. 45 W.	12.7	N. 69 W.	12.9
NE	4.1	N. 50 E.	6.7	N. 54 E.	7.6	N. 40 E.	7.6	N. 21 W.	9.0	N. 25 W.	13.0	N. 48 W.	15.8
ENE	3.9	N. 76 E.	5.5	N. 82 E.	6.2	S. 86 E.	6.8	N. 31 W.	8.5	S. 76 W.	12.6	N. 86 W.	18.2
E	3.6	S. 78 E.	5.8	S. 72 E.	6.4	S. 56 E.	6.6	N. 37 W.	8.6	N. 72 W.	12.0	N. 61 W.	15.2
ESE	3.6	S. 58 E.	5.6	S. 46 E.	6.2	S. 8 E.	7.0	S. 35 W.	9.0	N. 89 W.	12.8	N. 56 W.	18.2
SE	3.8	S. 22 E.	5.6	S. 3 E.	6.2	S. 38 W.	7.6	N. 80 W.	10.1	N. 77 W.	12.8	N. 84 W.	15.9
SSE	3.6	S.	6.0	S. 18 W.	7.2	S. 38 W.	8.8	S. 64 W.	11.2	S. 85 W.	16.5	N. 87 W.	21.1
S	4.2	S. 17 W.	7.5	S. 31 W.	9.0	S. 52 W.	10.1	S. 77 W.	12.0	W.	16.0	N. 86 W.	20.4
SSW	4.5	S. 31 W.	8.0	S. 50 W.	9.9	S. 66 W.	10.9	S. 85 W.	12.6	N. 83 W.	17.3	S. 87 W.	21.1
SW	4.4	S. 59 W.	8.4	S. 69 W.	10.2	S. 82 W.	11.0	N. 88 W.	12.9	N. 88 W.	17.5	N. 65 W.	20.7
WSW	4.3	S. 81 W.	8.2	S. 88 W.	9.9	N. 82 W.	11.1	N. 82 W.	13.8	N. 77 W.	20.1	N. 47 W.	15.3
W	4.9	N. 76 W.	8.8	N. 71 W.	10.2	N. 68 W.	11.3	N. 69 W.	14.1	N. 67 W.	19.7	N. 57 W.	25.8
WNW	5.6	N. 60 W.	8.8	N. 57 W.	10.4	N. 58 W.	11.9	N. 64 W.	15.0	N. 72 W.	21.2	N. 52 W.	26.4
NW	5.5	N. 41 W.	8.8	N. 39 W.	10.1	N. 40 W.	11.2	N. 48 W.	13.9	N. 60 W.	19.6	N. 45 W.	24.7
NNW	4.9	N. 22 W.	7.5	N. 22 W.	8.7	N. 26 W	9.6	N. 44 W.	12.2	N. 57 W.	19.0	N. 66 W.	23.3
Calm	0.0	W.	4.3	N. 74 W.	5.8	N. 65 W.	6.9	N. 62 W.	9.8	N. 50 W.	14.0	N. 38 W.	18.8

TABLE 5.—*Average free-air winds, m. p. s., for different surface directions*—Continued

(Figures in direction columns represent degrees)

GROUP 5

SUMMER

Surface		Altitude, meters											
		250		500		1,000		2,000		4,000		6,000	
Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
N	5.2	N. 11 E.	7.1	N. 7 E.	7.8	N.	8.5	N. 23 W.	9.7	N. 78 W.	11.6		
NNE	5.0	N. 27 E.	8.1	N. 27 E.	8.7	N. 20 E.	8.6	N. 18 W.	7.2	N. 67 W.	8.7	S. 67 W.	11.8
NE	5.4	N. 44 E.	7.4	N. 41 E.	7.7	N. 39 E.	8.0	N. 9 E.	7.8	N. 36 W.	10.2	N. 61 W.	13.9
ENE	4.4	N. 49 E.	6.2	N. 62 E.	6.1	N. 61 E.	5.9	N. 24 E.	7.0	N. 35 W.	10.6		
E	4.1	S. 86 E.	5.6	S. 82 E.	5.8	S. 89 E.	5.8	N. 8 W.	6.1	N. 62 W.	7.8	N. 52 W.	9.6
ESE	4.1	S. 58 E.	5.4	S. 57 E.	5.2	S. 34 E.	6.0	N. 86 W.	6.6	N. 63 W.	9.0		
SE	3.8	S. 26 E.	5.8	S. 26 E.	6.7	S. 28 E.	6.3	S. 14 W.	7.2	S. 72 W.	7.2	S. 76 W.	11.0
SSE	3.9	S. 14 E.	7.3	S. 10 E.	7.8	S. 2 E.	7.4	S. 36 W.	6.9	N. 85 W.	6.8		
S	4.6	S. 20 W.	7.9	S. 27 W.	9.1	S. 45 W.	8.5	S. 68 W.	8.3	S. 59 W.	10.7	S. 86 W.	11.3
SSW	4.6	S. 40 W.	8.1	S. 47 W.	9.2	S. 61 W.	8.8	S. 83 W.	8.5	N. 88 W.	10.4	S. 47 W.	12.2
SW	4.1	S. 63 W.	7.4	S. 73 W.	8.4	S. 82 W.	8.1	N. 79 W.	9.2	N. 50 W.	12.0	N. 65 W.	12.1
WSW	3.6	S. 78 W.	7.6	S. 84 W.	8.9	S. 89 W.	8.5	N. 81 W.	8.9	N. 75 W.	11.8	N. 65 W.	13.1
W	3.0	N. 86 W.	5.8	N. 78 W.	6.6	N. 77 W.	7.2	N. 66 W.	9.2	N. 81 W.	11.6	N. 74 W.	12.1
WNW	3.2	N. 50 W.	5.5	N. 38 W.	5.9	N. 38 W.	6.7	N. 44 W.	11.5	N. 65 W.	14.8		
NW	3.0	N. 22 W.	5.7	N. 15 W.	6.2	N. 21 W.	5.8	N. 37 W.	9.8	N. 44 W.	11.7		
NNW	4.5	N. 9 W.	6.7	N. 3 W.	7.4	N. 36 W.	7.2	N. 43 W.	10.2				
Calm	0.0	N. 4 W.	4.6	N. 6 E.	5.6	N. 10 E.	6.3	N. 8 E.	4.5				

WINTER

N	6.0	N. 4 E.	8.3	N. 1 E.	8.5	N. 27 W.	8.9	N. 65 W.	13.6	N. 67 W.	20.8		
NNE	4.7	N. 36 E.	7.5	N. 37 E.	7.9	N. 18 W.	7.3	N. 74 W.	11.1	N. 71 W.	20.9		
NE	5.2	N. 49 E.	8.2	N. 48 E.	9.0	N. 20 E.	7.8	N. 69 W.	10.4	N. 56 W.	15.9		
ENE	3.4	N. 79 E.	6.5	N. 85 E.	7.2	S. 14 W.	6.6	S. 89 W.	10.9	N. 79 W.	17.1		
E	3.3	S. 74 E.	6.7	S. 49 E.	6.6	S. 32 W.	7.9	S. 83 W.	11.4	W.	19.6	N. 83 W.	24.1
ESE	2.7	S. 61 E.	6.8	S. 38 E.	7.2	S. 8 W.	7.7	S. 63 W.	10.9				
SE	3.1	S. 19 E.	7.5	S. 11 W.	8.6	S. 54 W.	10.3	S. 82 W.	12.9	N. 86 W.	20.3		
SSE	3.2	S. 19 W.	8.0	S. 33 W.	9.4	S. 58 W.	11.8	S. 77 W.	16.5				
S	4.4	S. 28 W.	9.4	S. 42 W.	12.2	S. 59 W.	14.7	S. 76 W.	18.6	S. 87 W.	22.4		
SSW	4.9	S. 45 W.	11.3	S. 54 W.	14.0	S. 69 W.	16.6	S. 85 W.	20.0	N. 79 W.	24.5		
SW	4.6	S. 63 W.	10.4	S. 70 W.	12.9	S. 87 W.	15.0	W	19.4	N. 82 W.	27.5		
WSW	4.9	S. 78 W.	10.2	S. 88 W.	12.3	N. 82 W.	14.3	N. 77 W.	19.4	N. 83 W.	28.0		
W	5.1	N. 78 W.	9.8	N. 74 W.	11.7	N. 69 W.	12.9	N. 68 W.	17.3	N. 70 W.	25.3	N. 68 W.	29.0
WNW	4.3	N. 55 W.	8.4	N. 55 W.	9.3	N. 51 W.	10.6	N. 71 W.	16.0	N. 75 W.	25.6	N 71 W.	31.5
NW	4.9	N. 34 W.	8.4	N. 36 W.	10.0	N. 50 W.	11.3	N. 66 W.	15.6	N. 66 W.	26.0		
NNW	5.6	N. 18 W.	8.9	N. 20 W.	10.8	N. 33 W.	11.9	N. 54 W.	16.1	N. 74 W.	23.1		
Calm	0.0	N. 74 W.	5.8	S. 74 W.	7.0	N. 78 W.	9.4	W.	11.9	N. 86 W.	18.8		

ANNUAL

N	5.8	N. 8 E.	8.0	N. 6 E.	8.7	N. 11 W.	9.1	N. 48 W.	11.4	N. 71 W.	17.1	N. 61 W.	20.6
NNE	5.2	N. 30 E.	8.1	N. 30 E.	8.7	N. 12 W.	8.1	N. 37 W.	9.9	N. 58 W.	15.0	N. 73 W.	16.5
NE	5.0	N. 47 E.	7.4	N. 45 E.	8.0	N. 28 E.	8.9	N. 23 W.	9.9	N. 38 W.	13.5	N. 53 W.	16.7
ENE	4.3	N. 70 E.	6.7	N. 73 E.	6.8	N. 75 E.	6.6	N. 40 W.	8.3	N. 56 W.	12.5	N. 62 W.	16.7
E	4.1	S. 78 E.	6.2	S. 64 E.	6.4	S. 8 W.	7.0	N. 68 W.	8.9	N. 76 W.	12.8	N. 72 W.	15.2
ESE	4.0	S. 58 E.	6.9	S. 44 E.	7.0	S. 2 W.	7.4	S. 69 W.	8.5	W.	14.2	S. 75 W.	16.2
SE	3.7	S. 24 E.	6.8	S. 12 E.	7.6	S. 16 W.	8.2	S. 57 W.	10.2	S. 86 W.	13.6	S. 62 W.	20.8
SSE	3.9	S. 8 E.	7.9	S. 3 W.	8.3	S. 29 W.	8.9	S. 59 W.	10.5	S. 89 W.	14.6	S. 88 W.	19.4
S	4.6	S. 23 W.	9.2	S. 32 W.	11.2	S. 50 W.	9.2	S. 72 W.	13.0	S. 79 W.	17.1	N. 61 W.	20.0
SSW	4.5	S. 43 W.	9.8	S. 49 W.	11.5	S. 62 W.	12.1	S. 79 W.	13.3	N. 87 W.	16.1	S. 71 W.	16.7
SW	4.5	S. 61 W.	9.0	S. 70 W.	10.6	S. 80 W.	11.0	W.	12.6	N. 77 W.	17.2	N. 82 W.	20.0
WSW	4.4	S. 75 W.	8.8	S. 82 W.	10.2	N. 89 W.	10.7	N. 82 W.	13.0	N. 77 W.	17.8	N. 73 W.	18.2
W	4.2	N. 80 W.	8.0	N. 74 W.	9.3	N. 74 W.	9.9	N. 69 W.	13.2	N. 80 W.	18.5	N. 70 W.	20.6
WNW	4.2	N. 59 W.	7.9	N. 55 W.	8.5	N. 54 W.	9.4	N. 61 W.	12.8	N. 56 W.	19.6	N. 55 W.	22.2
NW	4.4	N. 28 W.	7.5	N. 27 W.	8.6	N. 38 W.	9.0	N. 53 W.	12.5	N. 59 W.	18.5	N. 60 W.	22.3
NNW	5.5	N. 14 W.	8.2	N. 10 W.	9.2	N. 24 W.	9.7	N. 45 W.	12.8	N. 49 W.	17.2	N. 63 W.	23.6
Calm	0.0	N. 41 W.	4.6	N. 43 W.	5.8	N. 29 W.	6.7	N. 69 W.	7.7	N. 77 W.	11.2	N. 80 W.	15.2

TABLE 5.—*Average free-air winds, m. p. s., for different surface directions*—Continued

(Figures in direction columns represent degrees)

GROUP 6

SUMMER

Surface		Altitude, meters											
		250		500		1,000		2,000		4,000		6,000	
Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
N	1.5	N. 7 W.	3.8	N. 34 W.	3.6	N. 32 W.	4.3	N. 51 W.	6.2	N. 15 W.	7.1		
NNE	2.3	N. 31 E.	3.7	N. 20 E.	3.0	N. 2 W.	4.3	N. 24 W.	6.8				
NE	2.6	N. 52 E.	5.5	N. 68 E.	6.7	N. 66 E.	6.8	N. 44 E.	7.0	N. 22 W.	8.2	N. 67 W.	8.7
ENE	3.9	N. 68 E.	6.2	N. 65 E.	7.4	N. 62 E.	8.1	N. 60 E.	8.2	N. 6 E.	7.9	N. 32 E.	9.9
E	3.9	E.	6.1	S. 88 E.	7.1	S. 86 E.	9.6	S. 89 E.	9.8	S. 74 E.	7.4	N. 39 W.	7.9
ESE	3.2	S. 59 E.	5.5	S. 41 E.	6.1	S. 38 E.	6.2	S. 53 E.	6.8	S.	4.9		
SE	2.8	S. 22 E.	5.2	S. 15 E.	6.3	S. 11 E.	6.6	S. 13 E.	7.0	S. 10 E.	7.8		
SSE	3.1	S. 9 E.	6.2	S. 5 E.	6.6	S. 18 E.	6.2	S. 21 E.	6.0				
S	2.5	S. 21 W.	6.1	S. 22 W.	7.4	S. 34 W.	7.5	S. 38 W.	8.1	S. 50 W.	8.4	N. 75 W.	7.3
SSW	3.2	S. 41 W.	4.8	S. 52 W.	4.9	S. 60 W.	5.5	S. 63 W.	6.0	S. 52 W.	6.2	S. 76 W.	6.5
SW	2.7	S. 64 W.	4.8	S. 73 W.	5.5	S. 76 W.	6.3	S. 80 W.	6.4	N. 86 W.	6.0	N. 57 W.	5.7
WSW	2.8	S. 70 W.	4.8	S. 72 W.	6.1	S. 65 W.	6.5	S. 85 W.	6.8	N. 75 W.	6.4		
W	3.0	N. 79 W.	5.4	N. 82 W.	6.1	N. 89 W.	6.3	N. 89 W.	6.8	N. 33 W.	7.1	N. 18 E.	7.8
WNW	2.8	N. 64 W.	5.0	N. 70 W.	5.9	N. 76 W.	5.5	N. 68 W.	5.5	N. 53 W.	5.6	N. 49 W.	5.9
NW	2.2	N. 29 W.	5.1	N. 65 W.	5.4	N. 80 W.	6.2	N. 62 W.	7.5				
NNW	2.9	N. 22 W.	4.4	N. 26 W.	4.7	N. 25 W.	4.7	N. 16 W.	6.5	N. 12 W.	6.0		
Calm	0.0	S. 81 W.	3.9	S. 75 W.	4.7	S. 74 W.	5.4	S. 80 W.	6.5	N. 88 W.	6.6	N. 88 W.	6.8

WINTER

Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
N	3.3	N.	6.3	N. 2 E.	7.2	N. 8 W.	8.7	N. 38 W.	11.9	N. 78 W.	17.0	N. 80 W.	25.4
NNE	3.6	N. 30 E.	6.5	N. 49 E.	6.8	N. 44 W.	6.3	N. 33 W.	7.1	N. 43 W.	10.1		
NE	3.0	N. 59 E.	6.7	N. 69 E.	8.2	N. 52 E.	8.0	N. 60 W.	8.2	N. 76 W.	13.8	N. 78 W.	20.6
ENE	4.0	E.	7.4	S. 80 E.	7.6	S. 21 E.	5.4	S. 44 W.	5.5	N. 81 W.	7.9		
E	3.1	S. 75 E.	7.5	S. 55 E.	9.8	S. 17 E.	8.7	S. 28 W.	7.7				
ESE	3.4	S. 42 E.	6.9	S. 33 E.	8.0	S. 15 E.	8.8	S. 18 W.	8.6	S. 72 W.	14.8		
SE	3.4	S. 12 E.	8.0	S. 4 W.	9.3	S. 30 W.	10.9	S. 38 W.	10.6	S. 59 W.	14.8		
SSE	4.6	S. 6 E.	9.9	S. 6 W.	12.5	S. 29 W.	12.9						
S	3.7	S. 7 W.	6.7	S. 20 W.	8.5	S. 45 W.	10.8	S. 76 W.	13.1	S. 87 W.	20.5		
SSW	4.4	S. 36 W.	9.7	S. 42 W.	11.7	S. 62 W.	14.5	S. 83 W.	16.4				
SW	3.7	S. 62 W.	7.0	S. 67 W.	8.5	S. 80 W.	10.6	N. 83 W.	14.4	N. 80 W.	19.3	N. 87 W.	20.9
WSW	5.3	S. 74 W.	7.4	S. 73 W.	8.6	S. 88 W.	11.3	S. 86 W.	16.8				
W	4.0	N. 85 W.	7.5	N. 79 W.	8.7	N. 75 W.	11.3	N. 77 W.	15.9	N. 78 W.	22.8	N. 68 W.	26.9
WNW	5.1	N. 60 W.	6.9	N. 58 W.	8.0	N. 60 W.	11.7	N. 65 W.	18.5	N. 68 W.	26.5		
NW	4.0	N. 37 W.	7.3	N. 38 W.	8.3	N. 43 W.	9.9	N. 59 W.	14.1	N. 72 W.	27.7	N. 60 W.	27.9
NNW	4.3	N. 21 W.	7.3	N. 18 W.	9.1	N. 27 W.	10.1	N. 49 W.	14.0	N. 68 W.	21.7		
Calm	0.0	N. 52 W.	4.3	S. 70 W.	5.5	N. 77 W.	6.8	N. 75 W.	8.4	N. 67 W.	14.4	N. 85 W.	23.0

ANNUAL

Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
N	2.8	N. 2 E.	5.7	N. 5 W.	6.2	N. 13 W.	6.8	N. 36 W.	9.0	N. 45 W.	12.9	N. 81 W.	15.9
NNE	3.1	N. 34 E.	6.0	N. 36 E.	6.2	N. 2 E.	6.5	N. 12 W.	7.6	N. 31 W.	9.9	N. 4 W.	12.9
NE	2.8	N. 58 E.	6.4	N. 66 E.	7.5	N. 59 E.	7.3	N. 2 W.	7.8	N. 42 W.	11.7	N. 66 W.	15.5
ENE	3.6	N. 80 E.	6.4	N. 86 E.	7.0	S. 81 E.	6.3	S. 70 E.	6.1	N. 49 W.	8.0	N. 57 W.	10.7
E	3.7	S. 80 E.	6.5	S. 72 E.	7.7	S. 61 E.	8.2	S. 54 E.	7.9	S. 86 W.	9.5	N. 75 W.	11.7
ESE	3.1	S. 58 E.	6.2	S. 47 E.	6.8	S. 40 E.	6.7	S. 12 E.	6.9	S. 42 W.	8.9	S. 59 W.	13.1
SE	3.1	S. 22 E.	7.0	S. 13 E.	8.3	S.	8.8	S. 10 W.	9.3	S. 43 W.	11.6	S. 48 W.	15.4
SSE	3.7	S. 12 E.	7.4	S. 5 E.	8.5	S. 2 E.	8.6	S. 3 W.	8.3	S. 51 W.	10.5	S. 8 E.	13.1
S	3.5	S. 12 W.	7.3	S. 18 W.	8.7	S. 30 W.	9.7	S. 48 W.	10.9	S. 66 W.	14.3	N. 86 W.	16.0
SSW	3.6	S. 38 W.	6.2	S. 49 W.	7.4	S. 59 W.	8.8	S. 72 W.	10.1	S. 67 W.	12.1	S. 83 W.	14.9
SW	3.4	S. 61 W.	6.2	S. 66 W.	7.5	S. 74 W.	8.6	S. 87 W.	10.5	N. 85 W.	13.0	N. 80 W.	14.8
WSW	3.5	S. 75 W.	6.2	S. 77 W.	7.2	S. 80 W.	8.2	S. 88 W.	12.0	N. 87 W.	14.0	N. 77 W.	16.6
W	3.5	N. 80 W.	6.3	N. 79 W.	7.1	N. 76 W.	8.4	N. 81 W.	10.9	N. 65 W.	15.6	N. 43 W.	17.3
WNW	4.2	N. 63 W.	6.3	N. 61 W.	7.2	N. 61 W.	8.4	N. 64 W.	12.0	N. 59 W.	15.2	N. 53 W.	17.6
NW	3.8	N. 40 W.	6.4	N. 44 W.	7.2	N. 51 W.	8.8	N. 59 W.	12.1	N. 44 W.	20.0	N. 50 W.	21.6
NNW	3.6	N. 20 W.	6.2	N. 22 W.	7.1	N. 25 W.	7.6	N. 33 W.	10.4	N. 48 W.	14.6	N. 41 W.	19.4
Calm	0.0	N. 37 W.	4.0	S. 73 W.	5.1	S. 86 W.	5.8	S. 84 W.	6.4	N. 72 W.	11.1	N. 72 W.	13.9

TABLE 5.—*Average free-air winds, m. p. s., for different surface directions*—Continued

(Figures in direction columns represent degrees)

GROUP 7

SUMMER

Surface		Altitude, meters											
		250		500		1,000		2,000		4,000		6,000	
Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
N	4.9	N. 2 E.	6.0	N. 3 E.	6.3	N. 9 W.	6.4	N. 26 E.	6.3				
NNE	4.8	N. 53 E.	6.5	N. 53 E.	7.2	N. 62 E.	7.9						
NE	4.5	N. 64 E.	5.2	N. 78 E.	5.6	N. 74 E.	5.1	N. 13 E.	4.5				
ENE	5.3	N. 74 E.	7.3	N. 82 E.	7.5	S. 80 E.	7.0						
E	5.9	S. 83 E.	7.4	S. 79 E.	7.4	S. 74 E.	7.7	S. 71 E.	6.9	S. 19 E.	6.9	S. 47 E.	7.0
ESE	5.7	S. 68 E.	7.9	S. 68 E.	8.2	S. 69 E.	7.5	S. 71 E.	6.1	S. 72 E.	5.8	S. 89 E.	7.0
SE	5.0	S. 53 E.	6.2	S. 57 E.	6.2	S. 61 E.	6.0	S. 77 E.	4.8	S. 82 E.	5.8	N. 81 E.	5.8
SSE	4.1	S. 32 E.	5.4	S. 41 E.	5.4	S. 63 E.	5.4	S. 33 E.	5.5	S. 10 E.	4.0		
S	4.9	S. 2 E.	6.2	S. 1 W.	6.6	S. 11 W.	5.7	S. 35 W.	4.9	S. 47 W.	6.2		
SSW	5.4	S. 29 W.	6.0	S. 29 W.	6.4	S. 50 W.	5.6	S. 43 W.	5.2				
SW	6.0	S. 45 W.	7.0	S. 47 W.	6.6	S. 73 W.	5.7	S. 82 W.	5.8				
WSW	5.0	S. 64 W.	6.4	S. 68 W.	6.6	S. 85 W.	6.4	S. 89 W.	7.5				
W	3.8	S. 79 W.	5.8	S. 85 W.	6.6	N. 86 W.	6.4						
WNW	4.0	N. 60 W.	6.5	N. 56 W.	7.1								
NW	3.0	N. 56 W.	5.2	N. 69 W.	6.0	W.	4.4						
NNW	3.5	N. 51 W.	5.6	N. 65 W.	6.0	N. 70 W.	5.9						
Calm	0.0												

WINTER

Surface		250		500		1,000		2,000		4,000		6,000	
Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
N	5.6	N. 4 E.	8.2	N. 4 E.	7.8	N. 28 W.	7.5	N. 51 W.	9.3	N. 80 W.	14.2		
NNE	4.8	N. 49 E.	7.0	N. 59 E.	7.4	S. 52 E.	5.9	N. 26 W.	5.1	S. 85 W.	8.9		
NE	5.1	N. 65 E.	9.0	N. 79 E.	9.1	S. 82 E.	7.5	N. 76 W.	6.2	N. 84 W.	9.5	N. 72 W.	13.4
ENE	5.5	N. 88 E.	10.0	S. 74 E.	9.8	S. 64 E.	8.9	S. 57 E.	8.7	S. 72 W.	9.0	N. 80 W.	13.5
E	5.4	S. 84 E.	8.1	S. 35 E.	9.0	S. 46 E.	8.0	S. 5 E.	7.0	S. 57 W.	8.5	S. 89 W.	16.1
ESE	6.2	S. 58 E.	9.0	S. 46 E.	9.7	S. 37 E.	9.7	S. 24 E.	7.9	S. 32 W.	9.4	S. 59 W.	14.4
SE	5.9	S. 35 E.	8.9	S. 35 E.	9.5	S. 6 E.	8.8	S. 5 E.	8.9	S. 29 W.	9.5	S. 60 W.	12.8
SSE	5.3	S. 23 E.	8.1	S. 8 E.	9.0	S. 9 E.	10.3	S. 15 W.	10.8				
S	4.6	S. 6 W.	7.6	S. 27 W.	9.0	S. 46 W.	8.6	S. 73 W.	10.7	S. 68 W.	17.5		
SSW	4.3	S. 22 W.	8.1	S. 27 W.	8.7	S. 42 W.	8.2	S. 70 W.	8.1				
SW	5.9	S. 57 W.	9.8	S. 75 W.	10.9	S. 82 W.	10.2	N. 82 W.	11.7	N. 87 W.	14.4		
WSW	6.1	S. 74 W.	8.7	S. 84 W.	9.1	N. 89 W.	10.3	S. 86 W.	13.6				
W	8.5	S. 86 W.	13.7	S. 81 W.	14.6	N. 68 W.	17.7						
WNW	3.4	N. 40 W.	7.4	N. 45 W.	11.7								
NW	7.1	N. 49 W.	10.4	N. 55 W.	9.9	N. 62 W.	13.5	N. 80 W.	18.7				
NNW	6.6	N. 31 W.	10.1	N. 32 W.	10.8	N. 51 W.	10.3	N. 59 W.	12.9				
Calm	0.0												

ANNUAL

Surface		250		500		1,000		2,000		4,000		6,000	
Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
N	5.6	N. 5 E.	7.4	N. 4 E.	7.6	N. 13 W.	7.4	N. 16 W.	8.0	N. 37 W.	10.7	N. 51 W.	13.0
NNE	4.8	N. 26 E.	7.1	N. 50 E.	7.5	N. 69 E.	6.7	N. 22 E.	6.4	S. 87 W.	7.2	W.	10.5
NE	5.3	N. 61 E.	8.1	N. 73 E.	8.4	N. 81 E.	6.8	N. 22 E.	6.5	N. 83 W.	8.4	N. 55 W.	11.6
ENE	5.5	N. 78 E.	8.8	S. 89 E.	8.9	S. 79 E.	8.2	S. 75 E.	7.1	N. 46 E.	8.2	N. 58 W.	11.1
E	5.9	S. 83 E.	8.1	S. 68 E.	8.7	S. 66 E.	8.1	S. 71 E.	6.5	S. 71 W.	7.0	N. 41 W.	11.4
ESE	5.9	S. 65 E.	8.7	S. 62 E.	9.2	S. 56 E.	8.4	S. 55 E.	6.7	S. 24 E.	7.7	W.	10.9
SE	5.2	S. 46 E.	7.5	S. 50 E.	7.8	S. 42 E.	7.0	S. 47 E.	6.2	S. 10 E.	7.3	N. 73 E.	9.8
SSE	5.2	S. 29 E.	7.1	S. 26 E.	7.1	S. 38 E.	7.6	S. 27 E.	7.7	S. 35 W.	7.8	S. 63 W.	11.2
S	4.5	S. 1 W.	6.2	S. 8 W.	7.0	S. 17 W.	6.6	S. 59 W.	7.3	S. 67 W.	10.1	S. 61 W.	12.4
SSW	4.8	S. 27 W.	6.3	S. 25 W.	6.7	S. 60 W.	6.5	S. 61 W.	6.6	S. 79 W.	9.5	N. 45 W.	8.9
SW	5.7	S. 48 W.	7.6	S. 61 W.	7.8	N. 82 W.	6.7	N. 57 W.	7.8	N. 76 W.	8.7	N. 56 W.	9.5
WSW	4.7	S. 69 W.	6.7	S. 80 W.	7.2	S. 83 W.	7.3	S. 88 W.	8.4	S. 82 W.	9.5		
W	5.2	S. 89 W.	7.3	N. 86 W.	7.7	N. 73 W.	8.8	N. 71 W.	10.1	N. 34 W.	10.1		
WNW	4.8	N. 59 W.	7.0	N. 59 W.	7.6	N. 62 W.	9.5	N. 75 W.	11.4	W.	13.1		
NW	5.4	N. 62 W.	7.9	N. 52 W.	8.6	N. 41 W.	9.0	N. 63 W.	11.7	N. 29 W.	15.3		
NNW	4.9	N. 32 W.	7.5	N. 35 W.	8.0	N. 47 W.	7.7	N. 45 W.	8.0	N. 60 W.	10.1		
Calm	0.0												

TABLE 5.—*Average free-air winds, m. p. s., for different surface directions*—Continued

(Figures in direction columns represent degrees)

GROUP 8

SUMMER

Surface		Altitude, meters											
		250		500		1,000		2,000		4,000		6,000	
Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
N	4.0	N. 13 E.	6.2	N. 12 E.	6.6	N. 6 E.	6.0	N. 13 W.	5.5	N. 41 W.	6.7	N. 21 W.	8.2
NNE	3.7	N. 54 E.	6.5	N. 60 E.	6.4	N. 51 E.	5.5	N. 2 E.	5.8	N. 31 W.	8.8	N. 36 W.	11.6
NE	4.0	N. 67 E.	6.2	N. 65 E	6.3	N. 51 E.	5.2	N. 10 E.	4.8	N. 15 W.	7.4	N. 33 W.	8.3
ENE	3.9	N. 80 E.	6.8	S. 88 E.	7.7	N. 82 E.	8.5	N. 73 E.	7.3	N. 69 W.	8.7		
E	3.2	S. 70 E.	4.6	S. 62 E.	4.7	S. 48 E.	5.9	N. 49 E.	5.8	N. 24 W.	6.5	N. 55 W.	7.4
ESE	3.4	S. 55 E.	5.4	S. 43 E.	5.9	S. 47 E.	6.7	S. 14 E.	5.5	S. 86 E.	7.8		
SE	3.8	S. 15 E.	8.3	S. 5 E.	10.2	S. 7 W.	8.1	S. 24 W.	6.8	N. 55 W.	7.3	N. 72 W.	9.4
SSE	4.5	S. 1 E.	8.7	S. 4 W.	10.2	S. 11 W.	8.7	S. 17 W.	6.8	N. 33 W.	6.4	N. 72 W.	7.8
S	5.0	S. 17 W.	9.9	S. 22 W.	11.5	S. 29 W.	9.6	S. 43 W.	7.5	S. 65 W.	7.9	N. 37 W.	9.5
SSW	4.8	S. 27 W.	8.7	S. 30 W.	10.4	S. 32 W.	8.6	S. 36 W.	7.6	N. 69 W.	8.1	N. 54 W.	8.2
SW	4.0	S. 52 W.	8.1	S. 53 W.	8.4	S. 52 W.	7.5	S. 41 W.	5.5	N. 8 E.	4.8	N. 34 W.	5.7
WSW	3.9	S. 79 W.	7.1	S. 79 W.	9.1	S. 77 W.	7.4	S. 78 W.	8.3				
W	2.9	S. 87 W.	5.1	S. 78 W.	5.5	S. 79 W.	6.2	N. 65 W.	7.7	N. 45 E.	12.1		
WNW	3.8	N. 44 W.	9.8	N. 23 W.	12.2	N. 8 W.	11.7	N. 13 E.	8.0				
NW	3.2	N. 26 W.	4.3	N. 33 W.	4.6	N. 70 W.	5.1	N. 54 W.	6.8	N. 41 E.	9.2		
NNW	4.0	N. 23 W.	6.0	N. 17 W.	7.2	N. 27 W.	6.6	N. 34 W.	6.0				
Calm	0.0	S. 45 W.	6.8	S. 62 W.	9.2	S. 44 W.	7.9	S. 52 W.	4.7				

WINTER

Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
N	6.4	N. 8 E.	9.5	N. 9 E.	10.2	N. 1 E.	10.9	N. 38 W.	12.3	N. 71 W.	19.5	N. 64 W.	20.2
NNE	5.0	N. 21 E.	7.6	N. 30 E.	8.3	N. 8 E.	9.1	N. 51 W.	9.9	N. 52 W.	16.1	N. 37 W.	21.3
NE	4.7	N. 53 E.	7.6	N. 46 E.	8.4	N. 67 E.	8.8	N. 76 W.	10.3	N. 67 W.	17.5		
ENE	3.1	N. 78 E.	6.2	N. 85 E.	6.7	S. 2 W.	5.3	S. 74 W.	7.2				
E	2.9	S. 55 E.	6.8	S. 23 E.	7.5	S. 20 W.	8.8	S. 58 W.	10.4	N. 41 W.	14.3		
ESE	3.9	S. 29 E.	7.1	S. 2 W.	7.8	S. 28 W.	9.0	S. 65 W.	9.7				
SE	4.1	S. 10 E.	8.3	S. 1 W.	10.0	S. 24 W.	10.1	S. 53 W.	12.6	S. 84 W.	16.5	S. 78 W.	17.1
SSE	5.5	S. 4 W.	11.8	S. 19 W.	14.3	S. 44 W.	14.4	S. 58 W.	14.1	S. 73 W.	16.8		
S	6.5	S. 18 W.	10.7	S. 33 W.	12.9	S. 50 W.	14.5	S. 68 W.	14.8	W.	18.3	N. 70 W.	20.8
SSW	5.3	S. 35 W.	9.3	S. 44 W.	11.2	S. 58 W.	12.4	S. 68 W.	12.7	N. 79 W.	15.7	N. 55 W.	20.0
SW	5.0	S. 56 W.	8.7	S. 62 W.	10.7	S. 77 W.	18.5	S. 87 W.	19.4	N. 67 W.	23.9	N. 39 W.	27.9
WSW	4.1	S. 81 W.	8.1	S. 89 W.	9.4	N. 87 W.	11.2	N. 89 W.	13.9	N. 76 W.	18.5		
W	4.9	N. 73 W.	8.3	N. 72 W.	9.9	N. 54 W.	11.6	N. 43 W.	14.9	N. 50 W.	21.0	N. 54 W.	26.9
WNW	5.7	N. 51 W.	8.9	N. 39 W.	9.8	N. 40 W.	11.8	N. 51 W.	15.1	N. 74 W.	22.7		
NW	6.6	N. 34 W.	9.6	N. 37 W.	10.9	N. 40 W.	12.8	N. 46 W.	17.1	N. 47 W.	24.7	N. 60 W.	34.7
NNW	5.9	N. 14 W.	9.8	N. 12 W.	11.0	N. 15 W.	12.1	N. 53 W.	15.5	N. 78 W.	23.4		
Calm	0.0	S. 21 W.	7.6	N. 57 W.	9.9	S. 40 W.	9.9	S. 77 W.	11.7				

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Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
N	5.6	N. 11 E.	8.7	N. 13 E.	9.4	N. 3 E.	9.1	N. 29 W.	10.0	N. 56 W.	14.2	N. 45 W.	18.2
NNE	4.4	N. 38 E.	7.7	N. 43 E.	8.0	N. 34 E.	7.8	N. 28 W.	7.7	N. 50 W.	12.5	N. 56 W.	17.1
NE	4.2	N. 57 E.	7.3	N. 56 E.	7.8	N. 58 E.	7.0	N. 22 W.	7.2	N. 58 W.	12.5	N. 58 W.	15.5
ENE	3.4	N. 80 E.	6.4	S. 88 E.	6.8	S. 82 E.	6.4	N. 13 E.	6.7	N. 79 W.	12.4	N. 60 W.	16.1
E	3.2	S. 68 E.	6.1	S. 58 E.	7.1	S. 55 E.	7.3	S. 28 W.	8.2	N. 59 W.	11.6	N. 52 W.	13.7
ESE	3.5	S. 59 E.	6.5	S. 27 E.	7.4	S. 15 E.	7.7	S. 27 W.	8.1	S. 16 W.	11.7	S. 63 W.	12.0
SE	4.3	S. 16 E.	9.2	S. 5 E.	10.9	S. 14 W.	10.0	S. 39 W.	10.2	W.	11.7	W.	13.5
SSE	5.4	S. 2 E.	10.8	S. 7 W.	12.4	S. 22 W.	11.6	S. 35 W.	10.3	W.	11.3	N. 72 W.	13.5
S	6.0	S. 12 W.	10.9	S. 23 W.	12.9	S. 36 W.	12.5	S. 60 W.	11.7	S. 79 W.	13.4	N. 59 W.	15.9
SSW	5.6	S. 30 W.	9.9	S. 34 W.	11.6	S. 39 W.	11.6	S. 58 W.	11.0	N. 81 W.	12.2	N. 59 W.	15.6
SW	5.0	S. 54 W.	8.8	S. 58 W.	9.7	S. 67 W.	11.6	S. 73 W.	12.7	N. 84 W.	15.2	N. 46 W.	17.4
WSW	4.4	S. 76 W.	8.2	S. 89 W.	9.7	S. 89 W.	9.8	N. 84 W.	12.3	N. 62 W.	16.7	N. 54 W.	18.7
W	4.2	N. 85 W.	8.9	N. 86 W.	9.0	N. 75 W.	9.8	N. 61 W.	12.4	N. 41 W.	16.1	N. 59 W.	19.1
WNW	4.6	N. 50 W.	8.8	N. 44 W.	10.4	N. 46 W.	10.8	N. 48 W.	12.6	N. 72 W.	16.3	N. 48 W.	24.6
NW	5.2	N. 32 W.	7.9	N. 35 W.	9.1	N. 48 W.	10.1	N. 50 W.	12.8	N. 32 W.	18.5	N. 50 W.	24.4
NNW	5.2	N. 24 W.	8.2	N. 16 W.	9.1	N. 18 W.	9.2	N. 42 W.	10.9	N. 68 W.	14.7	N. 48 W.	19.6
Calm	0.0	S. 26 W.	6.8	S. 42 W.	8.9	S. 54 W.	7.6	S. 80 W.	7.8	N. 46 W.	13.4	N. 41 W.	16.0

TABLE 5.—*Average free-air winds, m. p. s., for different surface directions*—Continued

(Figures in direction columns represent degrees)

GROUP 9

SUMMER

Surface		Altitude, meters											
		250		500		1,000		2,000		4,000		6,000	
Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
N	3.5	N. 6 E.	4.9	N. 12 E.	5.1	N. 1 W.	4.6	S. 73 W.	4.0	N. 75 W.	5.8		
NNE	3.7	N. 70 E.	5.4	N. 75 E.	5.4	N. 80 E.	5.7	N. 43 E.	6.0	S. 61 W.	7.3		
NE	3.3	N. 72 E.	4.6	N. 78 E.	5.1	S. 87 E.	4.5	N. 75 E.	5.1	N. 62 E.	4.3		
ENE	2.8	S. 89 E.	4.0	S. 88 E.	4.4	S. 80 E.	4.5	S. 33 E.	4.8	N. 87 E.	6.5	N. 8 W.	5.9
E	3.5	S. 65 E.	5.4	S. 56 E.	5.4	S. 51 E.	4.6	S. 48 E.	4.6	N. 17 E.	5.9		
ESE	4.2	S. 53 E.	5.7	S. 46 E.	6.0	S. 40 E.	5.5	S. 42 E.	5.0	S. 48 W.	5.5	N. 56 E.	5.4
SE	3.6	S. 35 E.	5.2	S. 28 E.	5.6	S. 20 E.	5.5	S. 27 E.	5.0	S. 39 W.	6.4	S. 72 W.	8.8
SSE	4.1	S. 19 E.	6.9	S. 17 E.	6.8	S. 9 E.	6.2	S. 6 E.	5.6	S. 22 W.	6.5	N. 70 W.	8.0
S	3.9	S. 8 W.	6.0	S. 1 W.	6.4	S. 8 W.	6.2	S. 22 W.	5.9	S. 25 W.	6.3	S. 12 W.	6.7
SSW	4.5	S. 20 W.	7.3	S. 14 W.	7.8	S. 15 W.	7.0	S. 10 W.	5.5	S. 65 W.	5.5	S. 13 W.	6.8
SW	3.5	S. 37 W.	6.4	S. 37 W.	7.0	S. 33 W.	6.0	S. 42 W.	4.8	S. 72 E.	6.1	N. 57 E.	8.8
WSW	2.2	S. 54 W.	4.9	S. 41 W.	5.1	S. 29 W.	3.5	S. 40 W.	2.4	S. 22 W.	4.3		
W	2.6	S. 78 W.	5.2	S. 64 W.	5.2	S. 47 W.	4.6	S. 17 W.	3.6	N. 37 E.	4.9	N. 48 E.	7.0
WNW	3.4	N. 83 W.	7.5	N. 70 W.	6.8	N. 78 W.	5.3	S. 42 W.	6.4				
NW	3.6	N. 51 W.	5.7	N. 67 W.	6.4	N. 84 W.	6.2	N. 36 W.	6.1	N.	7.8	N. 16 W.	10.0
NNW	2.9	N. 70 W.	4.9	S. 83 W.	4.6	S. 49 W.	4.3	N. 13 E.	4.4	N. 88 E.	7.1		
Calm	0.0	S. 14 W.	3.6	S. 6 W.	4.8	S. 15 E.	4.4	S. 83 E.	4.4	N. 73 E.	6.5		

WINTER

N	4.7	N. 12 E.	8.1	N. 13 E.	9.0	N.	9.1	N. 46 W.	10.1	N. 68 W.	17.1	N. 58 W.	21.1
NNE	4.7	N. 28 E.	7.3	N. 34 E.	7.2	N. 10 E.	6.5	N. 58 W.	7.3	N. 71 W.	16.9	N. 9 E.	20.1
NE	4.1	N. 58 E.	6.9	N. 63 E.	7.2	N. 50 E.	6.6	S. 62 W.	7.7	S. 70 W.	12.9		
ENE	3.2	N. 84 E.	6.2	S. 81 E.	5.9	S. 1 W.	5.6	N. 88 W.	7.3	N. 84 W.	14.3		
E	3.9	S. 68 E.	6.8	S. 53 E.	7.2	S. 17 E.	8.6	S. 33 W.	9.0	S. 79 W.	14.6	S. 72 W.	18.6
ESE	4.6	S. 49 E.	7.1	S. 34 E.	7.0	S. 4 E.	7.7	S. 50 W.	9.6	S. 71 W.	14.0	S. 87 W.	22.2
SE	3.8	S. 30 E.	8.0	S. 15 E.	9.4	S. 15 W.	9.1	S. 52 W.	10.4	S. 74 W.	14.6		
SSE	5.1	S. 15 E.	9.2	S. 16 E.	10.1	S. 19 W.	10.7	S. 50 W.	12.6	N. 73 W.	16.1		
S	5.4	S. 7 W.	8.7	S. 13 W.	10.1	S. 27 W.	11.3	S. 55 W.	11.5	S. 83 W.	14.1	S. 82 W.	18.7
SSW	6.2	S. 28 W.	9.3	S. 33 W.	10.2	S. 48 W.	11.2	S. 63 W.	12.7	S. 84 W.	14.9	N. 66 W.	16.6
SW	5.0	S. 45 W.	7.5	S. 48 W.	8.6	S. 68 W.	9.8	W.	11.5	N. 79 W.	15.9	N. 60 W.	17.6
WSW	3.8	S. 69 W.	8.2	S. 80 W.	9.0	N. 86 W.	10.0	N. 62 W.	11.5	N. 39 W.	18.3		
W	5.1	N. 73 W.	7.9	N. 70 W.	8.6	N. 65 W.	9.7	N. 61 W.	12.6	N. 56 W.	17.6	N. 52 W.	23.8
WNW	5.5	N. 62 W.	8.2	N. 58 W.	9.3	N. 49 W.	11.6	N. 44 W.	14.8	N. 57 W.	18.2		
NW	4.8	N. 40 W.	8.6	N. 34 W.	9.7	N. 40 W.	11.8	N. 53 W.	14.1	N. 58 W.	21.2	N. 47 W.	24.9
NNW	5.5	N. 14 W.	8.4	N. 12 W.	9.0	N. 20 W.	10.3	N. 35 W.	12.7	N. 48 W.	17.5	N. 4 W.	21.9
Calm	0.0	S. 16 W.	5.0	S. 25 W.	6.9	S. 39 W.	7.9	S. 76 W.	10.5				

ANNUAL

N	4.5	N. 10 E.	7.6	N. 12 E.	8.4	N. 1 W.	7.8	N. 28 W.	8.2	N. 74 W.	12.7	N. 85 W.	16.5
NNE	4.4	N. 45 E.	7.0	N. 48 E.	7.0	N. 36 E.	6.6	N. 14 W.	7.5	N. 66 W.	11.3	N. 28 W.	14.1
NE	3.9	N. 61 E.	6.5	N. 65 E.	6.8	N. 58 E.	6.3	N. 9 W.	6.8	N. 57 W.	10.1	N. 57 W.	14.3
ENE	3.6	N. 82 E.	6.1	S. 88 E.	6.0	S. 62 E.	5.4	N. 6 W.	5.9	N. 26 W.	9.4	N. 9 W.	11.5
E	3.7	S. 70 E.	6.4	S. 58 E.	6.6	S. 47 E.	6.6	S. 18 E.	7.0	N. 63 W.	10.5	N. 58 W.	13.8
ESE	4.4	S. 50 E.	5.6	S. 42 E.	6.9	S. 37 E.	6.7	S. 10 E.	7.1	S. 52 W.	9.1	N. 86 W.	13.3
SE	4.3	S. 34 E.	7.1	S. 26 E.	7.8	S. 14 E.	7.8	S. 14 W.	8.1	S. 64 W.	10.0	S. 87 W.	14.9
SSE	4.9	S. 17 E.	8.3	S. 16 E.	8.4	S.	8.7	S. 23 W.	9.0	S. 74 W.	11.3	N. 60 W.	13.3
S	5.1	S. 4 W.	8.2	S. 5 W.	9.3	S. 14 W.	9.5	S. 36 W.	8.9	S. 62 W.	10.5	S. 77 W.	13.9
SSW	5.4	S. 23 W.	8.4	S. 26 W.	9.3	S. 36 W.	9.7	S. 45 W.	10.1	S. 75 W.	12.4	S. 70 W.	15.4
SW	4.3	S. 40 W.	7.5	S. 42 W.	8.5	S. 50 W.	8.9	S. 75 W.	9.7	N. 66 W.	13.2	N. 50 W.	15.3
WSN	3.9	S. 62 W.	6.8	S. 64 W.	7.0	S. 75 W.	7.2	S. 70 W.	8.2	S. 76 W.	12.8	N. 20 W.	17.1
W	4.2	N. 81 W.	7.9	N. 81 W.	8.6	N. 79 W.	9.4	N. 83 W.	10.8	N. 54 W.	14.2	N. 33 W.	21.0
WNW	5.0	N. 70 W.	8.3	N. 63 W.	8.6	N. 62 W.	9.5	N. 74 W.	13.5	N. 39 W.	20.0	N. 11 W.	21.1
NW	4.4	N. 42 W.	7.9	N. 45 W.	8.5	N. 50 W.	9.0	N. 45 W.	10.4	N. 46 W.	15.7	N. 54 W.	16.9
NNW	4.8	N. 30 W.	7.7	N. 11 W.	8.2	N. 34 W.	8.4	N. 22 W.	10.6	N. 24 W.	15.1	N. 38 W.	17.1
Calm	0.0	S.	4.0	S. 16 E.	5.3	S. 9 E.	5.5	S. 35 W.	7.5	N.	10.3	W.	13.8

TABLE 6.—*Average percentage frequency of clockwise (cw.) and counterclockwise (ccw.) turning of winds from surface direction*

NORTHERN STATIONS—GROUPS 1–4, INCLUSIVE

SUMMER

Surface direction	Altitude, meters											
	250		500		1,000		2,000		4,000		6,000	
	cw.	ccw.	cw.	ccw.	cw.	ccw.	cw.	ccw.	cw.	ccw.	cw.	ccw.
N	32	27	39	32	39	46	26	63	20	71	15	79
NNE	44	14	45	20	44	42	36	62	29	67	54	46
NE	37	26	44	30	43	43	34	58	28	72	22	78
ENE	30	15	39	31	38	40	39	52	41	59	61	39
E	36	26	47	31	54	38	44	47	42	52	42	52
ESE	42	12	52	14	67	19	65	31	65	33	52	48
SE	56	17	61	24	67	23	64	31	71	25	69	29
SSE	53	14	68	18	75	16	78	18	88	12	88	12
S	48	14	61	16	74	15	83	12	82	12	76	20
SSW	40	19	58	12	72	15	85	9	84	16	89	0
SW	44	18	53	17	67	12	76	16	77	14	79	16
WSW	48	14	54	14	64	16	70	16	80	13	92	8
W	44	20	51	19	56	21	66	18	80	12	70	10
WNW	29	16	37	22	41	33	43	31	63	26	92	8
NW	42	17	44	23	44	32	35	43	39	53	55	37
NNW	36	20	41	25	30	49	28	66	7	72	0	87
Means	38	17	50	20	55	26	54	33	53	38	52	41

WINTER

N	38	27	39	34	25	53	22	72	27	67	18	82
NNE	39	26	43	30	35	45	21	74	12	79	12	88
NE	48	33	51	30	52	38	35	59	27	70	38	62
ENE	43	28	57	28	46	48	44	55	38	62	25	75
E	57	26	68	20	72	25	65	32	57	40	38	62
ESE	64	21	77	15	84	16	86	14	75	25	100	0
SE	68	10	84	8	94	6	93	7	91	9	100	0
SSE	70	9	86	6	94	1	98	1	92	8	75	25
S	59	8	76	5	94	2	97	2	100	0	92	8
SSW	62	8	79	4	94	3	96	0	100	0	89	11
SW	58	12	76	6	92	2	97	1	94	4	100	0
WSW	47	9	63	8	84	2	89	2	91	5	100	0
W	51	8	64	7	76	6	72	6	67	7	78	0
WNW	37	15	42	18	51	19	41	26	32	20	53	28
NW	29	24	35	24	34	26	27	45	23	51	14	36
NNW	31	25	35	30	23	47	7	70	6	91	0	100
Means	46	16	56	16	64	18	61	26	52	34	48	42

ANNUAL

N	34	30	38	34	32	46	22	64	24	69	19	73
NNE	42	21	44	26	34	47	24	69	16	78	26	74
NE	42	28	48	30	46	41	32	59	26	71	30	67
ENE	42	21	52	28	47	42	44	50	37	62	22	71
E	48	24	57	24	58	34	50	44	49	48	42	56
ESE	52	15	65	14	74	17	74	22	70	29	66	31
SE	62	13	72	14	79	15	79	17	78	20	84	16
SSE	59	9	74	8	83	6	89	7	91	8	85	15
S	51	11	67	10	82	7	89	6	90	6	86	12
SSW	45	16	62	10	76	9	86	6	92	8	83	12
SW	48	18	60	14	75	8	82	10	84	10	89	8
WSW	46	12	57	10	72	9	78	8	84	8	92	8
W	44	15	53	14	60	14	65	12	71	9	78	6
WNW	32	16	36	19	47	24	41	30	39	34	48	26
NW	35	20	40	24	38	29	33	44	27	50	29	46
NNW	34	22	38	25	34	41	18	62	11	77	12	75
Means	42	18	52	18	58	21	58	28	54	36	54	37

TABLE 6.—*Average percentage frequency of clockwise (cw.) and counterclockwise (ccw.) turning of winds from surface direction*—Continued

SOUTHERN STATIONS—GROUPS 5–9, INCLUSIVE

SUMMER

Surface direction	Altitude, meters											
	250		500		1,000		2,000		4,000		6,000	
	cw.	ccw.	cw.	ccw.	cw.	ccw.	cw.	ccw.	cw.	ccw.	cw.	ccw.
N	41	26	42	36	41	43	36	47	26	67	27	70
NNE	56	9	55	20	45	33	44	43	50	49	32	68
NE	50	16	56	19	56	29	38	51	40	55	26	70
ENE	39	23	46	28	45	35	35	41	33	48	16	80
E	41	18	51	23	54	26	53	27	58	34	54	43
ESE	40	18	51	19	51	26	49	34	49	39	44	54
SE	46	19	52	22	58	24	51	35	51	40	55	40
SSE	39	18	42	24	49	32	57	34	55	28	55	43
S	43	15	54	14	66	18	69	19	73	21	69	24
SSW	37	16	43	19	57	21	57	23	62	19	76	21
SW	36	19	45	23	50	24	56	24	72	24	66	30
WSW	31	26	34	34	39	37	44	36	61	34	52	42
W	25	31	34	40	38	48	52	32	65	28	68	20
WNW	44	16	51	19	51	30	58	35	52	39	72	22
NW	37	30	40	42	37	50	42	41	53	41	33	45
NNW	23	30	25	44	19	61	33	46	27	60	22	69
Means	38	18	45	22	49	26	49	31	51	35	49	43

WINTER

N	35	21	40	28	31	46	15	73	14	81	19	76
NNE	48	20	53	23	38	46	32	61	15	77	24	47
NE	50	23	58	26	54	39	47	51	41	54	25	69
ENE	50	16	67	16	77	18	65	35	60	37	23	77
E	58	19	68	19	73	23	70	26	61	37	61	39
ESE	61	9	79	9	88	7	89	7	97	3	94	6
SE	62	10	73	7	90	4	86	8	96	4	80	20
SSE	56	7	78	5	88	6	92	6	96	4	75	25
S	50	11	68	7	84	7	95	3	94	5	98	1
SSW	39	7	57	9	77	6	92	3	90	9	93	7
SW	45	17	57	19	70	10	87	7	87	6	95	4
WSW	43	20	49	17	67	11	68	10	71	16	100	0
W	41	15	57	18	71	12	65	14	57	27	71	8
WNW	44	13	53	15	62	15	44	27	37	38	38	38
NW	36	19	36	26	36	36	22	50	23	62	22	60
NNW	31	23	33	27	33	44	10	70	6	90	15	85
Means	44	15	55	17	61	22	56	29	56	37	55	36

ANNUAL

N	40	20	43	27	35	42	26	60	17	76	16	78
NNE	49	15	54	21	46	37	35	55	27	68	24	68
NE	46	20	54	24	53	34	41	49	35	59	26	69
ENE	46	20	56	21	58	28	47	40	42	50	24	70
E	46	18	55	20	61	25	59	31	58	37	50	47
ESE	46	14	61	18	66	17	67	22	73	23	75	23
SE	51	15	61	16	71	17	70	21	72	23	65	33
SSE	44	16	58	17	66	21	72	23	78	16	74	25
S	44	15	55	15	69	14	79	13	85	12	84	14
SSW	41	13	51	16	67	12	75	11	82	8	88	9
SW	40	23	51	23	61	18	75	15	82	12	84	13
WSW	35	21	46	23	56	23	62	20	70	23	63	29
W	37	21	48	25	55	26	56	22	56	28	70	15
WNW	36	16	46	18	49	23	43	37	37	44	56	29
NW	37	21	41	28	38	37	32	47	32	52	19	65
NNW	30	21	35	28	33	41	24	58	22	70	26	63
Means	41	16	50	20	54	23	53	31	52	37	51	41

TABLE 6.—*Average percentage frequency of clockwise (cw.) and counterclockwise (ccw.) turning of winds from surface direction*—Continued

ALL STATIONS—GROUPS 1–9, INCLUSIVE

SUMMER

Surface direction	Altitude, meters											
	250		500		1,000		2,000		4,000		6,000	
	cw.	ccw.	cw.	ccw.	cw.	ccw.	cw.	ccw.	cw.	ccw.	cw.	ccw.
N	37	27	41	34	40	44	31	54	23	69	21	74
NNE	51	11	50	20	45	37	40	51	41	57	43	57
NE	44	20	51	24	50	35	36	54	35	62	24	73
ENE	35	20	43	30	42	38	37	46	37	53	35	63
E	39	22	49	27	54	32	49	36	51	42	49	46
ESE	41	16	51	17	58	23	56	33	56	37	48	51
SE	50	18	56	23	62	24	56	33	60	33	61	35
SSE	45	16	53	21	60	25	66	27	67	22	68	31
S	45	15	57	14	70	17	75	16	77	17	72	22
SSW	38	17	50	16	64	19	69	17	71	17	82	12
SW	40	19	49	20	57	19	65	21	74	20	72	24
WSW	38	20	43	25	50	28	56	27	69	24	67	29
W	34	26	42	31	46	36	58	26	72	21	69	15
WNW	38	16	45	21	46	31	50	33	57	32	83	14
NW	39	25	42	34	40	42	39	42	47	46	43	41
NNW	29	26	32	35	24	56	31	55	17	66	10	79
Means	38	18	47	21	52	26	51	32	52	36	50	42

WINTER

N	36	24	39	31	30	49	18	73	20	75	19	79
NNE	44	23	49	26	36	46	27	67	14	78	18	67
NE	49	27	55	28	53	39	42	55	35	61	31	65
ENE	47	21	63	21	63	31	56	44	50	48	24	76
E	57	22	68	19	72	24	68	29	59	38	51	49
ESE	62	15	78	12	86	11	88	10	87	15	97	3
SE	65	10	78	7	92	5	89	8	94	6	89	11
SSE	63	8	81	5	91	3	95	4	94	6	75	25
S	54	10	71	6	88	5	96	3	97	3	95	4
SSW	49	8	67	7	84	5	94	2	94	5	91	9
SW	51	15	66	13	80	6	91	4	90	5	97	2
WSW	45	15	55	13	75	7	77	6	80	11	100	0
W	45	12	60	13	73	9	68	10	61	18	74	5
WNW	41	14	48	16	57	17	43	26	34	29	44	33
NW	33	21	36	25	35	31	24	48	23	56	18	48
NNW	31	24	34	28	28	45	9	70	6	91	9	91
Means	45	16	55	16	63	20	58	28	54	35	52	38

ANNUAL

N	38	25	41	30	34	44	24	62	20	73	18	64
NNE	46	18	49	23	41	41	30	61	22	73	25	71
NE	44	24	51	27	49	37	37	54	31	64	28	68
ENE	44	21	54	24	53	34	46	45	40	55	23	70
E	47	20	56	22	59	29	55	37	54	42	47	51
ESE	49	15	62	16	69	17	70	22	71	25	71	27
SE	56	14	66	15	75	16	74	19	75	22	73	25
SSE	51	13	66	13	74	14	80	16	84	12	79	21
S	47	13	60	12	75	11	84	10	88	9	85	13
SSW	42	14	56	14	71	11	80	9	86	8	86	10
SW	43	21	55	19	67	14	79	12	83	11	86	10
WSW	40	17	51	17	63	17.	69	15	76	16	76	20
W	40	18	50	20	58	20	60	17	63	19	74	10
WNW	34	16	42	19	48	23	42	34	38	40	46	25
NW	36	21	40	26	38	29	32	45	30	51	23	56
NNW	31	21	36	27	34	41	21	60	17	73	20	68
Means	41	17	51	19	56	22	55	29	53	36	52	39

TABLE 7.—*Average deviation, degrees, of free-air winds from surface direction*

NORTHERN STATIONS—GROUPS 1–4, INCLUSIVE

(Plus sign indicates turning to right, minus sign to left)

SUMMER

Surface direction	Altitude, meters					
	250	500	1,000	2,000	4,000	6,000
N	+3	+4	−4	−27	−35	−55
NNE	+6	+7	−6	−16	−70	−82
NE	+5	+7	−4	−36	−92	−119
ENE	+6	+5	−14	−37	−149	−138
E	+6	+11	+22	+12	+54	+97
ESE	+10	+14	+29	+42	----------	----------
SE	+20	+26	+47	+94	+130	+134
SSE	+16	+33	+50	+82	+136	+142
S	+12	+23	+34	+64	+100	+97
SSW	+7	+22	+34	+54	+80	+49
SW	+10	+16	+28	+37	+62	+64
WSW	+12	+17	+20	+29	+35	+55
W	+8	+14	+15	+20	+33	+30
WNW	+4	+6	+5	+4	+6	+16
NW	+8	+2	+2	−4	−10	−26
NNW	+3	+3	−10	−22	−40	−46

WINTER

N	+8	+4	−12	−46	−66	−60
NNE	+5	0	−16	−58	−94	−59
NE	+6	+10	−1	−102	−88	−118
ENE	+10	+18	+53	+33	−25	----------
E	+29	+55	+108	+179	+190	+202
ESE	+16	+43	+86	+140	----------	----------
SE	+32	+56	+81	+122	+128	----------
SSE	+25	+43	+68	+94	+118	----------
S	+22	+38	+62	+77	+96	----------
SSW	+22	+38	+55	+67	+79	----------
SW	+19	+31	+45	+54	+62	+68
WSW	+12	+18	+38	+38	+38	----------
W	+14	+19	+26	+24	+23	+31
WNW	+7	+8	+10	+6	0	----------
NW	+1	+4	+2	−6	−11	−17
NNW	+1	+5	−10	−28	−41	----------

ANNUAL

N	+3	+2	−8	−32	−45	−51
NNE	+7	+7	−12	−46	−70	−83
NE	+6	+9	−2	−71	−93	−102
ENE	+9	+14	+12	−86	−140	−136
E	+15	+23	+61	+116	+204	+209
ESE	+16	+30	+56	+108	+175	+179
SE	+22	+39	+65	+102	+136	+146
SSE	+16	+30	+54	+83	+118	+128
S	+16	+28	+45	+66	+86	+96
SSW	+12	+25	+39	+56	+74	+77
SW	+12	+20	+33	+33	+54	+62
WSW	+10	+15	+25	+32	+44	+56
W	+10	+14	+19	+22	+30	+36
WNW	+5	+7	+7	+4	+3	+7
NW	+4	+3	+3	−6	−11	−14
NNW	0	+2	−4	−23	−34	−37

TABLE 7.—*Average deviation, degrees, of free-air winds from surface direction*—Continued

SOUTHERN STATIONS—GROUP 5–9, INCLUSIVE

(Plus sign indicates turning to right, minus sign to left)

SUMMER

Surface direction	Altitude, meters					
	250	500	1,000	2,000	4,000	6,000
N	+5	0	−7	−36	−52	----------
NNE	+25	+25	+20	−21	−98	−96
NE	+15	+21	+20	−15	−48	−99
ENE	+4	+11	+13	+8	−71	−56
E	+11	+17	+20	−15	−50	−93
ESE	+9	+17	+22	+51	+69	----------
SE	+15	+19	+22	+29	+74	+85
SSE	+7	+8	+6	+21	+86	+131
S	+13	+15	+25	+41	+49	+86
SSW	+9	+12	+22	+25	+58	+44
SW	+7	+12	+18	+24	+54	+20
WSW	+6	+5	+6	+15	+17	+47
W	−2	−7	−7	−6	−8	−33
WNW	+8	+17	+18	+9	+8	+19
NW	+9	+5	−24	−2	+44	----------
NNW	−13	−20	−36	−9	----------	----------

WINTER

N	+6	+6	−12	−48	−73	−67
NNE	+11	+20	−20	−70	−88	−36
NE	+12	+14	+9	−125	−124	−120
ENE	+16	+27	+98	+160	+204	+212
E	+19	+47	+84	+129	+184	+176
ESE	+20	+38	+64	+102	+126	+141
SE	+24	+38	+68	+89	+113	+114
SSE	+13	+29	+50	+58	+112	----------
S	+13	+27	+45	+70	+83	+96
SSW	+11	+18	+34	+52	+73	+108
SW	+12	+19	+34	+47	+56	+73
WSW	+7	+15	+25	+29	+46	----------
W	+9	+11	+24	+25	+26	+30
WNW	+15	+17	+18	+10	+2	−3
NW	+6	+5	−2	−15	−16	−11
NNW	+2	+3	−7	−32	−45	----------

ANNUAL

N	+7	+6	−7	−31	−57	−65
NNE	+13	+19	+4	−36	−82	−72
NE	+12	+16	+12	−52	−101	−103
ENE	+10	+19	+30	−32	−101	−117
E	+14	+26	+46	+89	+190	+211
ESE	+10	+24	+39	+72	+103	+144
SE	+17	+24	+40	+60	+100	+81
SSE	+8	+15	+24	+41	+90	+96
S	+10	+17	+29	+55	+71	+94
SSW	+10	+15	+29	+41	+61	+76
SW	+8	+14	+29	+45	+57	+72
WSW	+3	+10	+16	+20	+26	+56
W	+7	+9	+15	+17	+35	+39
WNW	+8	+12	+11	+3	+5	+26
NW	+4	+4	−1	−9	+3	−8
NNW	−2	+3	−8	−15	−28	−26

TABLE 7.—*Average deviation, degrees, of free-air winds from surface direction*—Continued

ALL STATIONS—GROUPS 1–9, INCLUSIVE

(Plus sign indicates turning to right, minus sign to left)

SUMMER

Surface direction	Altitude, meters					
	250	500	1,000	2,000	4,000	6,000
N	+4	+1	−5	−32	−44	−48
NNE	+17	+17	+9	−17	−82	−92
NE	+11	+15	+9	−24	−70	−110
ENE	+5	+8	+1	−14	−104	−83
E	+9	+14	+21	−3	−4	−12
ESE	+10	+16	+25	+47	+110	----------
SE	+17	+22	+33	+58	+99	+109
SSE	+10	+19	+26	+48	+102	+136
S	+13	+18	+29	+51	+72	+92
SSW	+8	+17	+27	+38	+69	+46
SW	+8	+13	+22	+30	+58	+42
WSW	+8	+10	+11	+20	+26	+51
W	+3	+2	+3	+7	+10	−1
WNW	+6	+12	+11	+6	+7	+17
NW	+8	+4	−12	−4	+13	−26
NNW	−6	−9	−24	−17	−40	−46

WINTER

N	+6	+5	−12	−47	−70	−64
NNE	+8	+11	−18	−65	−103	−44
NE	+9	+12	+5	−115	−110	−119
ENE	+13	+23	+78	+104	+106	----------
E	+23	+50	+95	+151	+187	+182
ESE	+18	+40	+74	+119	+126	+141
SE	+27	+46	+74	+104	+117	+114
SSE	+18	+35	+58	+83	+114	----------
S	+17	+32	+53	+73	+89	+96
SSW	+16	+27	+43	+59	+76	+108
SW	+15	+25	+39	+50	+58	+71
WSW	+9	+16	+31	+33	+43	----------
W	+12	+15	+25	+24	+25	+30
WNW	+11	+13	+14	+8	+2	−3
NW	+4	+4	0	−11	−13	−14
NNW	+2	+4	−8	−31	−43	----------

ANNUAL

N	+5	+4	−7	−32	−51	−59
NNE	+10	+14	−3	−40	−76	−77
NE	+9	+13	+6	−60	−97	−102
ENE	+10	+15	+22	−56	−118	−125
E	+15	+25	+52	+146	+196	+210
ESE	+12	+26	+46	+88	+135	+160
SE	+19	+31	+51	+79	+116	+110
SSE	+12	+22	+37	+59	+102	+110
S	+13	+22	+36	+60	+77	+95
SSW	+11	+19	+34	+48	+66	+76
SW	+10	+17	+31	+40	+56	+68
WSW	+6	+13	+20	+25	+34	+56
W	+8	+11	+17	+19	+32	+37
WNW	+7	+10	+9	+4	+4	+17
NW	+4	+4	+1	−8	−3	−13
NNW	−1	+2	−6	−18	−31	−31

TABLE 8.—*Average increase, m. p. s. of free-air wind velocities above surface velocity*

[The average velocities at different heights, columns 3-8, may be found by simply adding to the values given the average surface velocity in column 2]

NORTHERN STATIONS—GROUPS 1–4, INCLUSIVE

SUMMER

Surface		Altitude, meters					
Direction	Velocity	250	500	1,000	2,000	4,000	6,000
N	4.0	2.2	2.7	3.3	5.2	8.4	11.1
NNE	4.1	2.4	2.7	2.7	3.5	7.2	11.8
NE	3.5	2.3	2.9	3.0	3.7	5.9	9.1
ENE	3.9	2.5	2.7	2.6	2.2	3.9	9.1
E	3.4	2.1	2.6	3.0	3.4	4.7	6.3
ESE	3.6	2.4	2.3	1.7	2.0	3.2	5.1
SE	3.8	2.5	2.9	2.7	2.9	5.6	7.9
SSE	3.9	2.6	3.6	3.6	5.4	5.5	8.2
S	4.2	3.3	4.1	4.4	4.9	6.7	9.5
SSW	3.8	4.2	5.1	4.9	5.3	8.5	10.4
SW	4.2	4.1	5.0	4.9	5.4	7.4	10.1
WSW	3.5	4.1	5.2	5.5	6.8	8.6	12.9
W	4.2	3.8	4.7	5.2	6.7	10.1	11.6
WNW	4.2	3.5	4.7	5.0	5.8	10.2	14.6
NW	4.2	2.8	3.4	4.0	6.7	10.2	14.0
NNW	4.4	2.4	3.2	3.7	6.1	9.3	12.1
Calm	0.0	3.5	4.4	5.2	6.5	9.2	11.4

WINTER

N	4.4	3.1	4.1	5.5	8.2	16.0	20.6
NNE	4.6	3.0	3.6	4.6	6.5	10.4	21.9
NE	4.2	2.7	3.5	3.9	7.2	13.7	18.4
ENE	4.2	2.6	2.9	3.9	6.4	11.2	--------
E	3.7	2.4	3.9	3.8	6.8	14.5	17.8
ESE	3.7	3.4	5.6	7.6	8.9	--------	--------
SE	4.0	3.3	5.2	6.6	9.2	15.0	--------
SSE	4.9	4.4	6.3	7.9	11.0	17.1	--------
S	5.1	5.0	6.7	8.1	10.5	17.0	--------
SSW	4.8	5.0	7.2	10.6	13.2	15.2	--------
SW	4.9	5.2	7.5	9.7	13.2	19.3	21.1
WSW	4.6	4.6	6.4	8.9	12.7	21.4	--------
W	5.4	4.2	6.2	8.4	12.3	19.5	--------
WNW	5.7	3.8	5.7	7.8	11.5	19.9	--------
NW	6.2	3.6	5.1	7.1	10.6	17.4	23.4
NNW	5.4	2.9	3.8	7.1	10.8	19.6	--------
Calm	0.0	4.0	7.0	9.1	13.0	19.5	--------

ANNUAL

N	4.5	2.8	3.5	4.2	6.5	11.6	16.0
NNE	4.1	2.6	3.1	3.4	5.5	9.6	14.6
NE	3.9	2.6	3.2	3.4	5.0	9.1	13.3
ENE	3.9	2.8	3.1	3.5	4.1	8.3	13.2
E	3.6	2.5	3.2	3.3	4.8	8.6	12.7
ESE	3.6	3.3	4.0	4.2	5.3	9.5	14.4
SE	4.1	2.9	4.1	4.5	5.8	9.2	12.6
SSE	4.6	3.6	4.8	5.5	7.4	12.0	15.7
S	5.0	4.4	5.8	6.3	7.4	11.1	14.7
SSW	4.9	4.9	6.1	7.3	8.5	12.1	15.0
SW	4.6	4.7	6.2	7.1	8.8	12.9	16.4
WSW	4.7	4.0	5.5	6.7	9.7	14.6	15.4
W	4.9	3.8	5.0	6.3	9.5	15.0	19.3
WNW	5.3	3.7	5.1	6.3	9.0	15.8	21.3
NW	5.4	3.3	4.3	5.5	8.5	13.9	18.4
NNW	5.3	2.8	3.6	5.3	8.2	14.8	17.4
Calm	0.0	4.3	5.6	7.0	9.2	14.0	17.6

TABLE 8.—*Average increase, m. p. s. of free-air wind velocities above surface velocity*—Continued

[The average velocities at different heights, columns 3-8, may be found by simply adding to the values given the average surface velocity in column 2]

SOUTHERN STATIONS—GROUPS 5-9, INCLUSIVE

SUMMER

Surface		Altitude, meters					
Direction	Velocity	250	500	1,000	2,000	4,000	6,000
N	3.8	1.8	2.1	2.1	2.5	4.3	--------
NNE	3.9	2.2	2.3	2.5	2.8	4.1	7.4
NE	4.0	1.8	2.3	1.9	1.9	3.7	6.3
ENE	4.1	2.1	2.6	2.7	2.8	4.7	4.6
E	4.1	1.7	2.0	2.6	2.5	2.8	3.8
ESE	4.1	1.9	2.1	2.3	1.9	2.5	--------
SE	3.8	2.4	3.2	2.7	2.4	3.1	4.6
SSE	3.9	2.9	3.5	2.8	2.2	1.8	3.5
S	4.2	2.9	4.0	3.3	2.7	3.7	4.8
SSW	4.5	2.4	3.4	2.7	2.0	3.2	4.2
SW	4.1	2.7	3.1	2.7	2.3	3.6	4.6
WSW	3.5	2.7	3.6	3.0	3.3	4.6	--------
W	3.1	2.4	2.9	3.1	3.9	6.1	6.1
WNW	3.4	3.4	4.1	4.0	4.6	7.2	--------
NW	3.0	2.2	2.8	2.5	4.6	6.3	--------
NNW	3.6	2.0	2.4	2.2	3.2	3.6	--------
Calm	0.0	4.8	6.1	5.9	5.0	6.6	6.8

WINTER

Direction	Velocity	250	500	1,000	2,000	4,000	6,000
N	5.2	2.9	3.3	3.8	6.2	12.5	17.4
NNE	4.6	2.7	3.0	2.4	3.6	10.0	15.8
NE	4.4	3.2	4.0	3.3	4.1	9.5	12.9
ENE	3.8	3.5	3.6	2.5	4.1	8.0	--------
E	3.7	3.4	4.2	4.7	5.4	10.4	15.4
ESE	4.2	3.3	3.8	4.4	5.1	8.0	12.9
SE	4.1	3.9	5.3	5.8	7.0	11.0	--------
SSE	4.7	4.6	6.3	7.3	8.7	11.1	--------
S	4.9	3.7	5.6	7.1	8.9	13.6	13.8
SSW	5.0	4.4	6.2	7.5	9.0	12.9	12.5
SW	4.8	3.8	5.4	8.0	10.4	15.4	17.6
WSW	4.8	3.6	4.9	6.6	10.2	17.3	--------
W	5.5	3.9	5.2	7.1	10.5	17.0	21.9
WNW	4.8	3.2	4.9	6.2	11.0	18.1	--------
NW	5.5	3.4	4.3	6.4	10.5	18.3	24.1
NNW	5.6	3.3	4.3	5.4	8.7	16.1	--------
Calm	0.0	5.7	7.4	8.5	10.6	16.7	--------

ANNUAL

Direction	Velocity	250	500	1,000	2,000	4,000	6,000
N	4.9	2.6	3.3	3.2	4.4	8.7	11.9
NNE	4.4	2.9	3.1	2.8	3.4	6.8	9.9
NE	4.2	2.9	3.5	3.1	3.4	7.0	10.5
ENE	4.1	2.8	3.0	2.5	2.7	6.0	9.2
E	4.1	2.6	3.1	3.4	3.6	6.2	9.1
ESE	4.2	2.6	3.3	3.2	3.3	6.1	9.0
SE	4.1	3.4	4.4	4.3	4.7	6.7	10.8
SSE	4.6	3.7	4.4	4.4	4.5	6.5	9.5
S	4.7	3.6	5.1	5.2	5.6	8.4	10.9
SSW	4.8	3.3	4.5	5.0	5.5	7.8	9.5
SW	4.6	3.3	4.0	4.8	6.1	8.9	10.8
WSW	4.4	3.1	4.0	4.2	6.3	9.6	11.6
W	4.3	3.2	4.1	4.9	7.3	10.6	15.5
WNW	4.6	3.1	3.9	5.0	7.9	12.3	16.9
NW	4.6	2.9	3.8	4.5	7.3	12.9	16.8
NNW	4.8	2.9	3.7	3.8	5.9	10.0	15.1
Calm	0.0	4.8	6.2	6.4	7.4	11.5	14.7

TABLE 8.—*Average increase, m. p. s. of free-air wind velocities above surface velocity*—Continued

[The average velocities at different heights, columns 3-8, may be found by simply adding to the values given the average surface velocity in column 2]

ALL STATIONS—GROUPS 1-9, INCLUSIVE

SUMMER

Surface		Altitude, meters					
Direction	Velocity	250	500	1,000	2,000	4,000	6,000
N	3.9	1.9	2.3	2.7	3.8	6.3	9.7
NNE	4.0	2.3	2.4	2.6	2.8	5.9	8.9
NE	3.7	2.0	2.6	2.5	2.7	4.8	7.9
ENE	4.0	2.3	2.6	2.7	2.5	4.4	6.1
E	3.8	1.8	2.2	2.8	2.9	3.6	4.9
ESE	3.9	2.1	2.2	2.0	1.9	2.7	3.1
SE	3.8	2.4	3.1	2.7	2.6	4.2	6.2
SSE	3.9	2.8	3.5	3.1	3.7	3.0	5.9
S	4.2	3.1	4.1	3.7	3.8	5.1	7.1
SSW	4.2	3.2	4.2	3.6	3.5	5.9	6.8
SW	4.1	3.4	3.9	3.7	3.7	5.6	7.2
WSW	3.5	3.3	4.2	3.9	4.6	6.6	11.2
W	3.6	3.1	3.8	4.0	5.3	7.8	8.8
WNW	3.8	3.5	4.4	4.6	5.2	9.0	10.9
NW	3.5	2.5	3.1	3.2	5.6	8.6	13.9
NNW	3.9	2.2	2.8	2.8	4.7	7.0	12.1
Calm	0.0	4.0	5.3	5.6	5.8	8.1	9.2

WINTER

Direction	Velocity	250	500	1,000	2,000	4,000	6,000
N	4.8	2.9	3.7	4.6	7.1	14.0	18.7
NNE	4.6	2.8	3.4	3.4	5.0	10.2	17.8
NE	4.3	3.1	3.7	3.6	5.5	11.0	15.7
ENE	4.0	3.0	3.2	3.2	5.1	9.4	--------
E	3.7	3.2	4.1	4.3	6.1	12.2	16.0
ESE	4.0	3.4	4.8	5.9	6.8	7.9	12.9
SE	4.0	3.6	5.2	6.1	8.0	12.2	--------
SSE	4.8	4.5	6.4	7.5	9.8	13.1	--------
S	5.0	4.3	6.2	7.5	9.6	15.1	--------
SSW	4.9	4.6	6.6	8.9	10.9	14.1	--------
SW	4.9	4.5	6.4	8.7	11.7	17.1	19.0
WSW	4.7	4.0	6.8	7.6	11.4	19.0	--------
W	5.5	4.0	5.7	7.7	11.4	18.3	23.3
WNW	5.2	3.5	5.3	7.0	11.3	18.9	--------
NW	5.8	3.5	4.7	6.7	10.6	17.9	23.7
NNW	5.5	3.2	4.2	6.2	9.5	17.7	--------
Calm	0.0	4.9	7.1	8.8	11.9	18.0	23.0

ANNUAL

Direction	Velocity	250	500	1,000	2,000	4,000	6,000
N	4.8	2.7	3.4	3.7	5.4	9.9	13.8
NNE	4.3	2.7	3.2	3.1	4.3	8.1	11.9
NE	4.1	2.8	3.4	3.2	4.1	8.0	11.7
ENE	4.0	2.8	3.0	2.9	3.4	7.0	11.0
E	3.9	2.5	3.2	3.4	4.1	7.2	10.7
ESE	3.9	2.9	3.6	3.6	4.2	7.6	11.4
SE	4.1	3.2	4.2	4.4	5.1	7.8	11.6
SSE	4.6	3.6	4.6	4.9	5.8	9.0	12.2
S	4.9	3.9	5.5	5.7	6.4	9.5	12.5
SSW	4.8	4.0	5.2	6.0	6.9	9.6	11.9
SW	4.6	3.8	4.9	5.7	7.3	10.6	13.2
WSW	4.5	3.6	4.7	5.3	7.8	11.9	13.2
W	4.6	3.5	4.5	5.5	8.2	12.6	17.4
WNW	4.9	3.4	4.4	5.5	8.4	13.8	19.1
NW	5.0	3.1	4.0	5.0	7.8	13.3	17.6
NNW	5.0	2.9	3.6	4.5	7.0	12.1	16.3
Calm	0.0	4.5	6.0	6.7	8.3	12.8	16.2

TABLE 9.—*Average free-air winds, m. p. s., for different surface directions*

NORTHERN STATIONS—GROUPS 1–4, INCLUSIVE

(Figures in direction column represent degrees)

SUMMER

Surface		Altitude, meters											
		250		500		1,000		2,000		4,000		6,000	
Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
N	4.0	N. 3 E.	6.2	N. 4 E.	6.7	N. 4 W.	7.3	N. 27 W.	9.2	N. 35 W.	12.4	N. 55 W.	15.1
NNE	4.1	N. 28 E.	6.5	N. 29 E.	6.8	N. 16 E.	6.8	N. 6 E.	7.6	N. 48 W.	11.3	N. 60 W.	15.9
NE	3.5	N. 50 E.	5.8	N. 52 E.	6.4	N. 41 E.	6.5	N. 9 E.	7.2	N. 47 W.	9.4	N. 74 W.	12.6
ENE	3.9	N. 74 E.	6.4	N. 73 E.	6.6	N. 54 E.	6.5	N. 31 E.	6.1	N. 81 W.	7.8	N. 70 W.	13.0
E	3.4	S. 84 E.	5.5	S. 79 E.	6.0	S. 68 E.	6.4	S. 78 E.	6.8	S. 36 E.	8.1	S. 7 W.	9.7
ESE	3.6	S. 58 E.	6.0	S. 54 E.	5.9	S. 39 E.	5.3	S. 26 E.	5.6				
SE	3.8	S. 25 E.	6.3	S. 19 E.	6.7	S. 2 W.	6.5	S. 49 W.	6.7	S. 85 W.	9.4	S. 89 W.	11.7
SSE	3.9	S. 6 E.	6.5	S. 11 W.	7.5	S. 28 W.	7.5	S. 60 W.	9.3	N. 24 W.	9.4	N. 60 W.	12.1
S	4.2	S. 12 W.	7.5	S. 23 W.	8.3	S. 34 W.	8.6	S. 64 W.	9.1	N. 90 W.	10.9	N. 93 W.	13.7
SSW	3.8	S. 29 W.	8.0	S. 44 W.	8.9	S. 56 W.	8.7	S. 76 W.	9.1	N. 78 W.	12.3	S. 71 W.	14.2
SW	4.2	S. 55 W.	8.3	S. 61 W.	9.2	S. 73 W.	9.1	S. 82 W.	9.6	N. 73 W.	11.6	N. 71 W.	14.3
WSW	3.5	S. 80 W.	7.6	S. 85 W.	8.7	S. 88 W.	9.0	N. 83 W.	10.3	N. 77 W.	12.1	N. 57 W.	16.4
W	4.2	N. 82 W.	8.0	N. 76 W.	8.9	N. 75 W.	9.4	N. 70 W.	10.9	N. 57 W.	14.3	N. 60 W.	15.8
WNW	4.2	N. 64 W.	7.7	N. 62 W.	8.9	N. 63 W.	9.2	N. 64 W.	10.0	N. 62 W.	14.4	N. 52 W.	18.8
NW	4.2	N. 37 W.	7.0	N. 43 W.	7.6	N. 43 W.	8.2	N. 49 W.	10.9	N. 55 W.	14.4	N. 71 W.	18.2
NNW	4.4	N. 19 W.	6.8	N. 19 W.	7.6	N. 32 W.	8.1	N. 44 W.	10.5	N. 62 W.	13.7	N. 68 W.	16.5

WINTER

N	4.4	N. 8 E.	7.5	N. 4 E.	8.5	N. 12 W.	9.9	N. 46 W.	12.6	N. 66 W.	20.4	N. 60 W.	25.0
NNE	4.6	N. 27 E.	7.6	N. 22 E.	8.2	N. 6 E.	9.2	N. 36 W.	11.1	N. 72 W.	15.0	N. 37 W.	26.5
NE	4.2	N. 51 E.	6.9	N. 55 E.	7.7	N. 44 E.	8.1	N. 57 W.	11.4	N. 43 W.	17.9	N. 73 W.	22.6
ENE	4.2	N. 78 E.	6.8	N. 86 E.	7.1	S. 59 E.	8.1	S. 79 E.	10.6	N. 43 E.	15.4		
E	3.7	S. 61 E.	6.1	S. 35 E.	7.6	S. 18 W.	7.5	S. 89 W.	10.5	N. 80 W.	18.2	N. 68 W.	21.5
ESE	3.7	S. 52 E.	7.1	S. 25 E.	9.3	S. 18 W.	11.3	S. 72 W.	12.6				
SE	4.0	S. 13 E.	7.3	S. 11 W.	9.2	S. 36 W.	10.6	S. 77 W.	13.2	S. 83 W.	19.0		
SSE	4.9	S. 3 W.	9.3	S. 21 W.	11.2	S. 46 W.	12.8	S. 72 W.	15.9	N. 84 W.	22.0		
S	5.1	S. 22 W.	10.1	S. 38 W.	11.8	S. 62 W.	13.2	S. 77 W.	15.6	N. 84 W.	22.1		
SSW	4.8	S. 44 W.	9.8	S. 60 W.	12.0	S. 77 W.	15.4	S. 89 W.	18.0	N. 79 W.	20.0		
SW	4.9	S. 64 W.	10.1	S. 76 W.	12.4	W.	14.6	N. 81 W.	18.1	N. 73 W.	24.2	N. 67 W.	26.0
WSW	4.6	S. 80 W.	9.2	S. 86 W.	11.0	N. 74 W.	13.5	N. 74 W.	17.3	N. 74 W.	26.0		
W	5.4	N. 76 W.	9.6	N. 71 W.	11.6	N. 64 W.	13.8	N. 66 W.	17.7	N. 65 W.	24.9		
WNW	5.7	N. 61 W.	9.5	N. 60 W.	11.4	N. 58 W.	13.5	N. 62 W.	17.2	N. 68 W.	25.6		
NW	6.2	N. 44 W.	9.8	N. 41 W.	11.3	N. 43 W.	13.3	N. 51 W.	16.8	N. 56 W.	23.6	N. 62 W.	29.6
NNW	5.4	N. 21 W.	8.3	N. 17 W.	9.2	N. 32 W.	12.5	N. 50 W.	16.2	N. 63 W.	25.0		

ANNUAL

N	4.5	N. 3 E.	7.3	N. 2 E.	8.0	N. 8 W.	8.7	N. 52 W.	11.0	N. 45 W.	16.1	N. 51 W.	20.5
NNE	4.1	N. 29 E.	6.7	N. 29 E.	7.2	N. 10 E.	7.5	N. 24 W.	9.6	N. 48 W.	13.7	N. 61 W.	18.7
NE	3.9	N. 51 E.	6.5	N. 54 E.	7.1	N. 43 E.	7.3	N. 26 W.	8.9	N. 48 W.	13.0	N. 57 W.	17.2
ENE	3.9	N. 77 E.	6.7	N. 82 E.	7.0	N. 80 E.	7.4	N. 18 W.	8.0	N. 72 W.	12.2	N. 68 W.	17.1
E	3.6	S. 75 E.	6.1	S. 67 E.	6.8	S. 29 E.	6.9	S. 26 W.	8.4	N. 66 W.	12.2	N. 61 W.	16.3
ESE	3.6	S. 52 E.	6.9	S. 38 E.	7.6	S. 12 E.	7.8	S. 40 W.	8.9	N. 73 W.	13.1	N. 69 W.	18.0
SE	4.1	S. 23 E.	7.0	S. 6 E.	8.2	S. 20 W.	8.6	S. 57 W.	9.9	N. 89 W.	13.3	N. 79 W.	16.7
SSE	4.6	S. 6 E.	8.2	S. 8 W.	9.4	S. 32 W.	10.1	S. 61 W.	12.0	N. 84 W.	16.6	N. 74 W.	20.3
S	5.0	S. 16 W.	9.4	S. 28 W.	10.8	S. 45 W.	11.3	S. 66 W.	12.4	S. 86 W.	16.1	N. 84 W.	19.7
SSW	4.9	S. 34 W.	9.8	S. 47 W.	11.0	S. 61 W.	12.2	S. 78 W.	13.4	N. 84 W.	17.0	N. 81 W.	19.9
SW	4.6	S. 57 W.	9.3	S. 65 W.	10.8	S. 78 W.	11.7	S. 78 W.	13.4	N. 81 W.	17.5	N. 73 W.	21.0
WSW	4.7	S. 78 W.	8.7	S. 83 W.	10.2	N. 87 W.	11.4	N. 80 W.	14.4	N. 68 W.	19.3	N. 56 W.	20.1
W	4.9	N. 80 W.	8.7	N. 76 W.	9.9	N. 71 W.	11.2	N. 68 W.	14.4	N. 60 W.	19.9	N. 54 W.	24.2
WNW	5.3	N. 63 W.	9.0	N. 61 W.	10.4	N. 61 W.	11.6	N. 64 W.	14.3	N. 65 W.	21.1	N. 61 W.	26.6
NW	5.4	N. 41 W.	8.7	N. 42 W.	9.7	N. 42 W.	10.9	N. 51 W.	13.9	N. 56 W.	19.3	N. 59 W.	23.8
NNW	5.3	N. 22 W.	8.1	N. 20 W.	8.9	N. 26 W.	10.6	N. 45 W.	13.5	N. 56 W.	20.1	N. 59 W.	22.7

TABLE 9.—*Average free-air winds, m. p. s., for different surface directions*—Continued

(Figures in direction column represent degrees)

SOUTHERN STATIONS—GROUPS 5–9, INCLUSIVE

SUMMER

Surface		Altitude, meters											
		250		500		1,000		2,000		4,000		6,000	
Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
N	3.8	N. 5 E.	5.6	N.	5.9	N. 7 W.	5.9	N. 36 W.	6.3	N. 52 W.	8.1		
NNE	3.9	N. 47 E.	6.1	N. 47 E.	6.2	N. 42 E.	6.4	N. 1 E.	6.7	N. 76 W.	8.0	N. 74 W.	11.3
NE	4.0	N. 60 E.	5.8	N. 66 E.	6.3	N. 65 E.	5.9	N. 30 E.	5.9	N. 3 W.	7.7	N. 54 W.	10.3
ENE	4.1	N. 72 E.	6.2	N. 79 E.	6.7	N. 81 E.	6.8	N. 76 E.	6.9	N. 3 W.	8.8	N. 12 E.	8.7
E	4.1	S. 79 E.	5.8	S. 72 E.	6.1	S. 70 E.	6.7	N. 75 E.	6.6	N. 40 E.	6.9	N. 3 W.	7.9
ESE	4.1	S. 59 E.	6.0	S. 51 E.	6.2	S. 46 E.	6.4	S. 17 E.	6.0	S. 1 W.	6.6		
SE	3.8	S. 30 E.	6.2	S. 26 E.	7.0	S. 23 E.	6.5	S. 16 E.	6.2	S. 29 W.	6.9	S. 40 W.	8.4
SSE	3.9	S. 15 E.	6.8	S. 14 E.	7.4	S. 16 E.	6.7	S. 1 E.	6.1	S. 64 W.	5.7	N. 71 W.	7.4
S	4.2	S. 13 W.	7.1	S. 15 W.	8.2	S. 25 W.	7.5	S. 41 W.	6.9	S. 49 W.	7.9	S. 86 W.	9.0
SSW	4.5	S. 31 W.	6.9	S. 34 W.	7.9	S. 44 W.	7.2	S. 47 W.	6.5	S. 80 W.	7.7	S. 66 W.	8.7
SW	4.1	S. 52 W.	6.8	S. 57 W.	7.2	S. 63 W.	6.8	S. 69 W.	6.4	S. 81 W.	7.7	S. 65 W.	8.7
WSW	3.5	S. 74 W.	6.2	S. 73 W.	7.1	S. 74 W.	6.5	S. 83 W.	6.8	S. 85 W.	8.1		
W	3.1	S. 88 W.	5.5	S. 83 W.	6.0	S. 83 W.	6.2	S. 84 W.	7.0	S. 82 W.	9.2	S. 57 W.	9.2
WNW	3.4	N. 60 W.	6.8	N. 51 W.	7.5	N. 50 W.	7.4	N. 59 W.	8.0	N. 60 W.	10.6		
NW	3.0	N. 36 W.	5.2	N. 40 W.	5.8	N. 69 W.	5.5	N. 47 W.	7.6	N. 1 W.	9.3		
NNW	3.6	N. 35 W.	5.6	N. 42 W.	6.0	N. 58 W.	5.8	N. 31 W.	6.8				

WINTER

N	5.2	N. 6 E.	8.1	N. 6. E.	8.5	N. 12 W.	9.0	N. 48 W.	11.4	N. 73 W.	17.7	N. 67 W.	22.6
NNE	4.6	N. 33 E.	7.3	N. 42 E.	7.6	N. 2 E.	7.0	N. 48 W.	8.2	N. 66 W.	14.6	N. 14 W.	20.4
NE	4.4	N. 57 E.	7.6	N. 59 E.	8.4	N. 54 E.	7.7	N. 80 W.	8.5	N. 79 W.	13.9	N. 75 W.	17.3
ENE	3.8	N. 84 E.	7.3	S. 85 E.	7.4	S. 14 E.	6.3	S. 48 W.	7.9	N. 88 W.	11.8		
E	3.7	S. 71 E.	7.1	S. 43 E.	7.9	S. 6 E.	8.4	S. 39 W.	9.1	N. 86 W.	14.1	S. 86 W.	19.1
ESE	4.2	S. 48 E.	7.5	S. 30 E.	8.0	S. 4 E.	8.6	S. 34 W.	9.3	S. 58 W.	12.2	S. 73 W.	17.1
SE	4.1	S. 21 E.	8.0	S. 7 E.	9.4	S. 23 W.	9.9	S. 44 W.	11.1	S. 68 W.	15.1		
SSE	4.7	S. 9 E.	9.3	S. 7 W.	11.0	S. 28 W.	12.0	S. 36 W.	13.4	W.	15.8		
S	4.9	S. 13 W.	8.6	S. 27 W.	10.5	S. 45 W.	12.0	S. 70 W.	13.8	S. 83 W.	18.5	N. 84 W.	18.7
SSW	5.0	S. 33 W.	9.4	S. 40 W.	11.2	S. 56 W.	12.5	S. 74 W.	14.0	N. 85 W.	17.9	N. 68 W.	17.5
SW	4.8	S. 57 W.	8.1	S. 64 W.	10.2	S. 79 W.	12.8	N. 88 W.	15.2	N. 79 W.	20.2	N. 62 W.	22.4
WSW	4.8	S. 75 W.	8.4	S. 83 W.	9.7	N. 87 W.	11.4	N. 83 W.	15.0	N. 66 W.	22.1		
W	5.5	N. 81 W.	9.4	N. 79 W.	10.7	N. 66 W.	12.6	N. 65 W.	16.0	N. 64 W.	22.5	N. 60 W.	27.4
WNW	4.8	N. 53 W.	8.0	N. 51 W.	9.7	N. 50 W.	11.0	N. 58 W.	15.8	N. 66 W.	22.9		
NW	5.5	N. 39 W.	8.9	N. 40 W.	9.8	N. 47 W.	11.9	N. 60 W.	16.0	N. 61 W.	23.8	N. 56 W.	29.6
NNW	5.6	N. 20 W.	8.9	N. 19 W.	9.9	N. 29 W.	11.0	N. 54 W.	14.3	N. 67 W.	21.7		

ANNUAL

N	4.9	N. 7 E.	7.5	N. 6 E.	8.2	N. 7 W.	8.1	N. 31 W.	9.3	N. 57 W.	13.6	N. 65 W.	16.8
NNE	4.4	N. 35 E.	7.3	N. 41 E.	7.5	N. 26 E.	7.2	N. 12 W.	7.8	N. 60 W.	11.2	N. 50 W.	14.3
NE	4.2	N. 57 E.	7.1	N. 61 E.	7.7	N. 57 E.	7.3	N. 7 W.	7.6	N. 56 W.	11.2	N. 58 W.	14.7
ENE	4.1	N. 78 E.	6.9	N. 87 E.	7.1	S. 82 E.	6.6	N. 36 E.	6.8	N. 33 W.	10.1	N. 49 W.	13.3
E	4.1	S. 76 E.	6.7	S. 64 E.	7.2	S. 44 E.	7.5	S. 1 E.	7.7	N. 80 W.	10.3	N. 59 W.	13.2
ESE	4.2	S. 58 E.	6.8	S. 44 E.	7.5	S. 29 E.	7.4	S. 4 W.	7.5	S. 35 W.	10.3	S. 76 W.	13.2
SE	4.1	S. 28 E.	7.5	S. 21 E.	8.5	S. 5 E.	8.4	S. 15 W.	8.8	S. 55 W.	10.8	S. 36 W.	14.9
SSE	4.6	S. 14 E.	8.3	S. 7 E.	9.0	S. 2 W.	9.0	S. 19 W.	9.1	S. 68 W.	11.1	S. 74 W.	14.1
S	4.7	S. 10 W.	8.3	S. 17 W.	9.8	S. 29 W.	9.9	S. 55 W.	10.3	S. 71 W.	13.1	N. 86 W.	15.6
SSW	4.8	S. 32 W.	8.1	S. 37 W.	9.3	S. 51 W.	9.8	S. 63 W.	10.3	S. 83 W.	12.6	N. 82 W.	14.3
SW	4.6	S. 53 W.	7.9	S. 59 W.	8.6	S. 74 W.	9.4	W.	10.7	N. 78 W.	13.5	N. 63 W.	15.4
WSW	4.4	S. 71 W.	7.5	S. 78 W.	8.4	S. 84 W.	8.6	S. 88 W.	10.7	N. 86 W.	14.0	N. 56 W.	16.0
W	4.3	N. 83 W.	7.5	N. 81 W.	8.4	N. 75 W.	9.2	N. 73 W.	11.6	N. 55 W.	14.9	N. 51 W.	19.8
WNW	4.6	N. 60 W.	7.7	N. 56 W.	8.5	N. 57 W.	9.6	N. 65 W.	12.5	N. 63 W.	16.9	N. 42 W.	21.5
NW	4.6	N. 41 W.	7.5	N. 41 W.	8.4	N. 46 W.	9.1	N. 54 W.	11.9	N. 42 W.	17.5	N. 53 W.	21.4
NNW	4.8	N. 24 W.	7.7	N. 19 W.	8.5	N. 30 W.	8.5	N. 37 W.	10.7	N. 50 W.	14.8	N. 48 W.	19.9

TABLE 9.—*Average free-air winds, m. p. s., for different surface directions*—Continued

(Figures in direction column represent degrees)

ALL THE STATIONS—GROUPS 1-9, INCLUSIVE

SUMMER

Surface		Altitude, meters											
		250		500		1,000		2,000		4,000		6,000	
Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
N	3.9	N. 4 E.	5.8	N. 1 E.	6.2	N. 5 W.	6.6	N. 32 W.	7.7	N. 44 W.	10.2	N. 48 W.	13.6
NNE	4.0	N. 39 E.	6.3	N. 39 E.	6.4	N. 31 E.	6.6	N. 5 E.	6.8	N. 60 W.	9.9	N. 70 W.	12.9
NE	3.7	N. 56 E.	5.7	N. 60 E.	6.3	N. 54 E.	6.2	N. 21 E.	6.4	N. 25 W.	8.5	N. 65 W.	11.6
ENE	4.0	N. 73 E.	6.3	N. 76 E.	6.6	N. 69 E.	6.7	N. 54 E.	6.5	N. 36 W.	8.4	N. 15 W.	10.1
E	3.8	S. 81 E.	5.6	S. 76 E.	6.0	S. 69 E.	6.6	N. 87 E.	6.7	N. 86 E.	7.4	N. 78 E.	8.7
ESE	3.9	S. 58 E.	6.0	S. 52 E.	6.1	S. 43 E.	5.9	S. 21 E.	5.8	S. 42 W.	6.6	----------	----------
SE	3.8	S. 28 E.	6.2	S. 23 E.	6.9	S. 12 E.	6.5	S. 13 W.	6.4	S. 54 W.	8.0	S. 64 W.	10.0
SSE	3.9	S. 12 E.	6.7	S. 3 E.	7.4	S. 4 W.	7.0	S. 26 W.	7.6	S. 80 W.	6.9	N. 64 W.	9.8
S	4.2	S. 13 W.	7.3	S. 18 W.	8.3	S. 29 W	7.9	S. 51 W.	8.0	S. 72 W.	9.3	N. 88 W.	11.3
SSW	4.2	S. 30 W.	7.4	S. 39 W.	8.4	S. 49 W.	7.8	S. 60 W.	7.7	N. 89 W.	10.1	S. 68 W.	11.0
SW	4.1	S. 53 W.	7.5	S. 58 W.	8.0	S. 67 W.	7.8	S. 75 W.	7.8	N. 73 W.	9.7	S. 87 W.	11.3
WSW	3.5	S. 76 W.	6.8	S. 78 W.	7.7	S. 79 W.	7.4	S. 88 W.	8.1	N. 86 W.	10.1	N. 61 W.	14.7
W	3.6	N. 87 W.	6.7	N. 88 W.	7.4	N. 87 W.	7.6	N. 83 W.	8.9	N. 80 W.	11.4	S. 89 W.	12.4
WNW	3.8	N. 62 W.	7.3	N. 56 W.	8.2	N. 57 W.	8.4	N. 62 W.	9.0	N. 61 W.	12.8	N. 51 W.	14.7
NW	3.5	N. 37 W.	6.0	N. 41 W.	6.6	N. 57 W.	6.7	N. 49 W.	9.1	N. 32 W.	12.1	N. 71 W.	17.4
NNW	3.9	N. 28 W.	6.1	N. 31 W.	6.7	N. 46 W.	6.7	N. 39 W.	8.6	N. 62 W.	10.9	N. 68 W.	16.0

WINTER

N	4.8	N. 6 E.	7.7	N. 5 E.	8.5	N. 12 W.	9.4	N. 47 W.	11.9	N. 70 W.	18.8	N. 64 W.	23.5
NNE	4.6	N. 30 E.	7.4	N. 33 E.	8.0	N. 4 E.	8.0	N. 43 W.	9.6	N. 81 W.	14.8	N. 32 W.	22.4
NE	4.3	N. 54 E.	7.4	N. 57 E.	8.0	N. 50 E.	7.9	N. 70 W.	9.8	N. 65 W.	15.3	N. 74 W.	20.0
ENE	4.0	N. 81 E.	7.0	S. 89 E.	7.2	S. 34 E.	7.2	S. 8 E.	9.1	S. 6 E.	13.4	----------	----------
E	3.7	S. 67 E.	6.9	S. 40 E.	7.8	S. 5 W.	8.0	S. 61 W.	9.8	N. 83 W.	15.9	N. 88 W.	19.7
ESE	4.0	S. 50 E.	7.4	S. 28 E.	8.8	S. 6 W.	9.9	S. 51 W.	10.8	S. 58 W.	11.9	S. 73 W.	16.9
SE	4.0	S. 18 E.	7.6	S. 1 W.	9.2	S. 29 W.	10.1	S. 59 W.	12.0	S. 72 W.	16.2	----------	----------
SSE	4.8	S. 4 E.	9.3	S. 13 W.	11.2	S. 36 W.	12.3	S. 61 W.	14.6	S. 92 W.	17.9	----------	----------
S	5.0	S. 17 W.	9.3	S. 32 W.	11.2	S. 53 W.	12.5	S. 73 W.	14.6	S. 89 W.	20.1	----------	----------
SSW	4.9	S. 38 W.	9.5	S. 49 W.	11.5	S. 65 W.	13.8	S. 81 W.	15.8	N. 82 W.	19.0	----------	----------
SW	4.9	S. 60 W.	9.4	S. 70 W.	11.3	S. 84 W.	13.6	N. 85 W.	16.6	N. 77 W.	22.0	N. 64 W.	23.9
WSW	4.7	S. 77 W.	8.7	S. 84 W.	11.5	N. 81 W.	12.3	N. 79 W.	16.1	N. 69 W.	23.7	----------	----------
W	5.5	N. 78 W.	9.5	N. 75 W.	11.2	N. 65 W.	13.2	N. 66 W.	16.9	N. 65 W.	23.8	N. 60 W.	28.8
WNW	5.2	N. 57 W.	8.7	N. 55 W.	10.5	N. 54 W.	12.2	N. 60 W.	16.5	N. 66 W.	24.1	----------	----------
NW	5.8	N. 41 W.	9.3	N. 41 W.	10.5	N. 45 W.	12.5	N. 56 W.	16.4	N. 58 W.	23.7	N. 59 W.	29.5
NNW	5.5	N. 20 W.	8.7	N. 18 W.	9.7	N. 30 W.	11.7	N. 53 W.	15.0	N. 65 W.	23.2	----------	----------

ANNUAL

N	4.8	N. 5 E.	7.5	N. 4 E.	8.2	N. 7 W.	8.5	N. 32 W.	10.2	N. 51 W.	14.7	N. 59 W.	18.6
NNE	4.3	N. 32 E.	7.0	N. 36 E.	7.5	N. 19 E.	7.4	N. 18 W.	8.6	N. 54 W.	12.4	N. 55 W.	16.2
NE	4.1	N. 54 E.	6.9	N. 58 E.	7.5	N. 51 E.	7.3	N. 15 W.	8.2	N. 52 W.	12.1	N. 57 W.	15.8
ENE	4.0	N. 78 E.	6.8	N. 83 E.	7.0	E.	6.9	N. 12 E.	7.4	N. 50 W.	11.0	N. 57 W.	15.0
E	3.9	S. 75 E.	6.4	S. 65 E.	7.1	S. 38 E.	7.3	S. 56 W.	8.0	N. 74 W.	11.1	N. 60 W.	14.6
ESE	3.9	S. 56 E.	6.8	S. 42 E.	7.5	S. 22 E.	7.5	S. 20 W.	8.1	S. 67 W.	11.5	N. 88 W.	15.3
SE	4.1	S. 26 E.	7.3	S. 14 E.	8.3	S. 6 W.	8.5	S. 34 W.	9.2	S. 71 W.	11.9	S. 65 W.	15.7
SSE	4.6	S. 10 E.	8.2	S.	9.2	S. 15 W.	9.5	S. 37 W.	10.4	S. 80 W.	13.6	S. 88 W.	16.8
S	4.9	S. 13 W.	8.8	S. 22 W.	10.4	S. 36 W.	10.6	S. 60 W.	11.3	S. 77 W.	14.4	N. 85 W.	17.4
SSW	4.8	S. 33 W.	8.8	S. 41 W.	10.0	S. 56 W.	10.8	S. 70 W.	11.7	S. 88 W.	14.4	N. 82 W.	16.7
SW	4.6	S. 55 W.	8.4	S. 62 W.	9.5	S. 76 W.	10.3	S. 85 W.	11.9	N. 79 W.	15.2	N. 67 W.	17.8
WSW	4.5	S. 74 W.	8.1	S. 81 W.	9.2	S. 88 W.	9.8	N. 87 W.	12.3	N. 78 W.	16.4	N. 56 W.	17.7
W	4.6	N. 82 W.	8.1	N. 79 W.	9.1	N. 73 W.	10.1	N. 71 W.	12.8	N. 58 W.	17.2	N. 53 W.	22.0
WNW	4.9	N. 61 W.	8.3	N. 58 W.	9.3	N. 59 W.	10.4	N. 64 W.	13.3	N. 64 W.	18.7	N. 51 W.	24.0
NW	5.0	N. 41 W.	8.1	N. 41 W.	9.0	N. 44 W.	10.0	N. 53 W.	12.8	N. 48 W.	18.3	N. 58 W.	22.6
NNW	5.0	N. 23 W.	7.9	N. 20 W.	8.6	N. 28 W.	9.5	N. 40 W.	12.0	N. 53 W.	17.1	N. 53 W.	21.3

4. *Frequency of free-air winds from different directions.*—The frequency of different directions at the earth's surface is fairly well known, or at any rate can be readily obtained from climatological summaries, for all parts of the country. For the year as a whole there is in general comparatively little variation, although westerly winds are somewhat more frequent than are easterly, except during summer in Florida and southern Texas (Groups 7 and 9). There is also in all sections a seasonal swing from a slight preponderance of south component winds in summer to a similar preponderance of north component winds in winter, with the single exception of the plains States (Group 8) in which southerly winds are more frequent than northerly throughout the year. For the most part calms are observed only about 1 to 2 per cent of the time, but in Group 6 the frequency is 14 per cent in summer and autumn with an average of 9 for the year.

In Table 10 and Figure 7 are shown not only the frequencies of different directions at the surface, above discussed, but also those for various levels in the upper air. Table 10 contains seasonal and annual values at the surface, 250, 500, 1,000, 2,000, 4,000, and 6,000 meters, and Figure 7 presents curves showing the frequencies for summer and winter only, at the surface, 1,000, 2,000, and 4,000 meters. In section 5 a series of charts in Figures 10 and 11 gives similar information in a different form for 500 and 1,000 meters, the more usual flying levels, and includes the average velocities for the different directions.

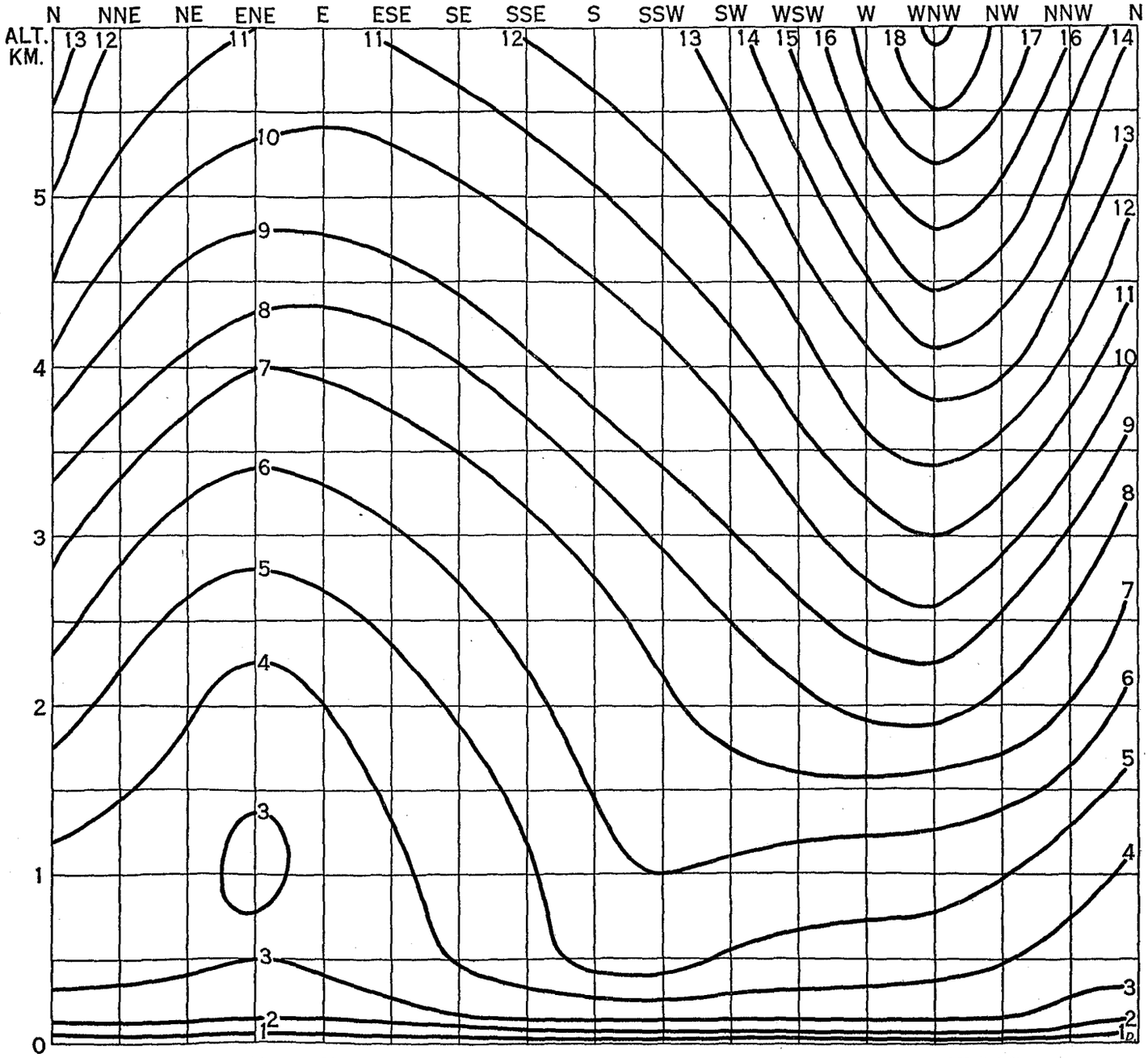

FIG. 6.—Average annual increase of free-air wind velocities above surface velocity for different surface directions in eastern and central United States

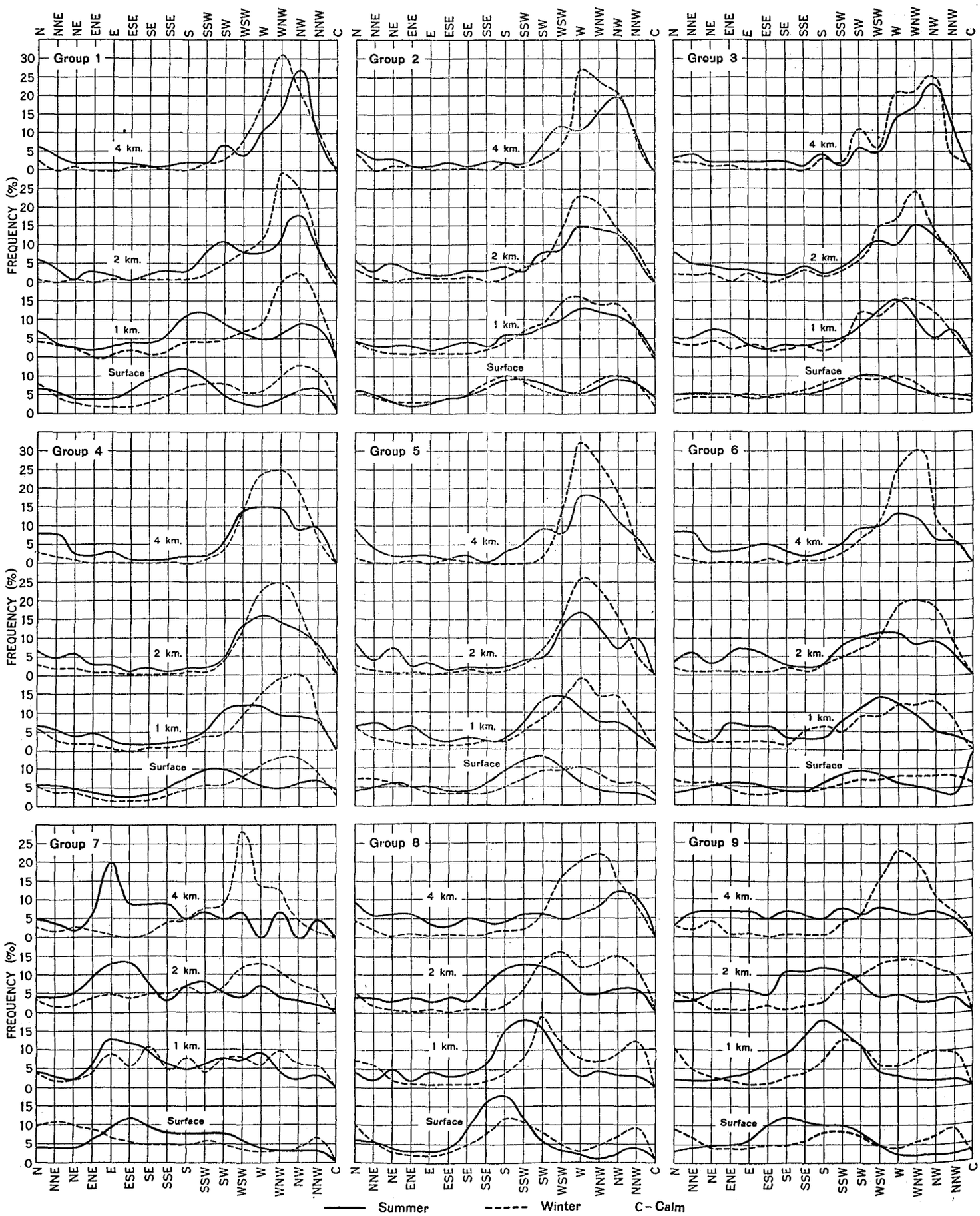

FIG. 7.—Average summer and winter percentage frequency of free-air winds from different directions at selected altitudes in eastern and central United States

As may be seen from Table 10 and Figure 7, there is in most parts of the country a pronounced swing above the surface to westerly directions as those of greatest frequency. This tendency is strongest in winter and increases with altitude in all seasons. For example, in the Northern States, west component winds prevail at 4 kilometers 90 to 95 per cent of the time in winter, about 80 in summer and 85 to 90 for the year as a whole. In the Southern States a west component is still strongly predominant in winter, but much less pronounced in summer. In the extreme South, i. e., Florida and southern Texas, an east component is more frequent than a west at all levels in summer. Generally speaking, a south component in the winds at upper levels occurs more frequently than a north component in the Southern States, whereas the opposite condition is found in the Northern States. These characteristics are well shown in Tables 11 and 12 which give the seasonal and annual percentage frequency of a west and north component respectively (and, by subtraction from 100, the frequency of east and south also) for all nine groups. These tables include data for 8 and 10 kilometers and show that at these heights the wind frequencies do not differ materially from those at 4 and 6, although, as Table 3 indicates, the velocities themselves are considerably greater.

TABLE 10.—*Average percentage frequency of free-air winds from different directions*

GROUP 1

SPRING

Direction	Surface	Altitude, meters					
		250	500	1,000	2,000	4,000	6,000
N	8	9	9	6	4	2	3
NNE	7	5	5	3	3	4	0
NE	6	5	5	3	3	1	5
ENE	5	4	3	3	3	1	0
E	4	5	4	3	1	0	1
ESE	5	5	5	5	3	1	0
SE	7	7	5	5	3	0	1
SSE	8	7	7	6	3	0	0
S	9	10	10	7	4	1	0
SSW	8	9	8	9	7	2	3
SW	5	5	7	8	9	4	3
WSW	4	5	5	7	10	13	11
W	4	3	5	7	11	25	25
WNW	5	5	4	7	16	21	22
NW	7	9	9	11	14	16	15
NNW	8	7	9	10	6	9	11
Calm	[1] 0	[1] 0	0	0	0	0	0

SUMMER

N	7	5	6	7	6	6	8
NNE	6	5	5	4	4	4	2
NE	4	5	5	3	1	2	1
ENE	4	3	3	2	3	2	0
E	4	4	3	3	2	2	1
ESE	6	4	4	4	1	2	0
SE	9	8	5	4	2	1	1
SSE	11	11	9	6	3	1	1
S	12	14	15	11	3	2	1
SSW	9	12	12	12	8	2	0

[1] Less than 0.5 per cent.

TABLE 10.—*Average percentage frequency of free-air winds from different directions*—Continued

GROUP 1—Continued

SUMMER—Continued

Direction	Surface	Altitude, meters					
		250	500	1,000	2,000	4,000	6,000
SW	5	7	7	9	11	7	3
WSW	3	3	4	7	8	4	10
W	2	3	3	5	8	11	22
WNW	4	3	4	6	11	16	15
NW	6	5	7	9	18	27	31
NNW	7	8	8	8	10	10	4
Calm	1	[1] 0	[1] 0	0	1	1	0

AUTUMN

N	7	6	6	7	4	4	9
NNE	5	5	4	2	1	0	0
NE	3	4	4	2	1	1	2
ENE	3	2	1	1	1	1	0
E	3	2	2	2	1	1	2
ESE	3	2	2	2	[1] 0	0	0
SE	4	4	3	3	[1] 0	0	0
SSE	8	6	5	2	2	1	2
S	12	11	9	9	3	2	0
SSW	9	14	14	13	9	2	2
SW	5	6	8	8	9	11	4
WSW	5	5	5	6	10	9	7
W	6	5	7	8	16	20	26
WNW	8	7	7	11	19	21	19
NW	10	12	10	16	14	19	18
NNW	8	9	13	8	10	8	9
Calm	1	[1] 0	0	0	0	0	0

WINTER

N	8	7	7	4	1	3	3
NNE	5	4	4	3	[1] 0	0	0
NE	3	2	2	2	1	1	0
ENE	2	2	1	[1] 0	[1] 0	0	2
E	2	2	2	1	1	0	2
ESE	2	2	1	2	1	1	0
SE	3	3	2	1	1	1	0
SSE	5	3	3	2	1	[1] 0	8
S	7	6	5	4	1	0	0
SSW	8	6	5	4	2	2	0
SW	8	8	7	5	5	3	3
WSW	6	7	6	7	8	8	3
W	6	6	9	9	14	18	33
WNW	10	9	12	20	29	31	11
NW	13	19	18	22	25	21	30
NNW	11	14	16	14	10	11	5
Calm	1	0	0	0	0	0	0

ANNUAL

N	7	7	7	6	4	4	2
NNE	6	5	4	3	2	2	[1] 6
NE	4	4	4	3	1	1	0
ENE	3	3	2	1	1	1	1
E	3	3	3	2	1	1	2
ESE	4	3	3	3	1	1	0
SE	6	5	4	3	2	1	1
SSE	8	7	6	4	2	1	3
S	10	10	10	8	3	1	[1] 0
SSW	8	10	10	9	7	2	1
SW	6	7	7	8	9	6	3
WSW	5	5	5	7	9	8	8
W	4	4	6	8	12	19	26
WNW	7	6	7	11	19	22	16
NW	9	11	11	14	18	21	24
NNW	9	10	11	10	9	9	7
Calm	1	[1] 0	[1] 0	0	[1] 0	[1] 0	0

[1] Less than 0.5 per cent.

TABLE 10.—*Average percentage frequency of free-air winds from different directions*—Continued

GROUP 2

Direction	Surface	Altitude, meters 250	500	1,000	2,000	4,000	6,000
SPRING							
N	7	6	6	6	6	8	8
NNE	5	3	4	4	4	5	4
NE	4	2	3	3	4	4	5
ENE	3	3	3	3	3	2	1
E	3	3	2	2	2	1	1
ESE	3	3	2	2	1	2	2
SE	5	3	3	2	2	2	3
SSE	7	6	6	4	1	1	0
S	10	14	9	6	4	1	1
SSW	10	9	10	8	6	4	2
SW	7	7	8	11	8	6	4
WSW	5	6	9	12	13	7	9
W	5	9	9	12	16	14	20
WNW	7	7	8	9	12	19	12
NW	9	10	10	10	10	14	22
NNW	8	9	8	6	8	10	6
Calm	2	[1] 0	[1] 0	[1] 0	[1] 0	0	0
SUMMER							
N	6	5	6	4	6	6	6
NNE	5	4	4	3	3	3	2
NE	3	3	3	3	5	3	3
ENE	2	3	3	3	3	1	2
E	3	3	2	2	2	1	2
ESE	4	2	3	3	2	2	2
SE	5	4	4	4	3	1	1
SSE	7	6	4	3	3	2	1
S	9	11	8	6	4	2	3
SSW	9	6	7	6	3	2	2
SW	8	10	9	8	8	7	8
WSW	6	9	9	10	9	12	11
W	5	6	11	13	15	11	14
WNW	7	9	9	12	14	16	14
NW	9	10	9	11	13	20	18
NNW	8	8	8	8	7	10	11
Calm	4	1	1	1	0	1	[1] 0
AUTUMN							
N	5	4	5	4	4	3	4
NNE	3	3	3	2	2	2	4
NE	2	2	2	1	2	2	1
ENE	2	2	1	1	[1] 0	1	0
E	3	1	2	1	[1] 0	0	0
ESE	4	2	2	1	1	0	0
SE	5	3	2	1	1	[1] 0	0
SSE	8	6	4	2	1	1	1
S	11	12	10	5	2	3	1
SSW	11	10	9	9	7	5	2
SW	8	8	9	12	9	9	6
WSW	7	11	12	13	15	10	12
W	6	9	11	18	19	19	17
WNW	8	9	12	13	19	20	24
NW	8	10	9	12	12	19	17
NNW	7	8	7	5	6	6	10
Calm	2	[1] 0	[1] 0	[1] 0	0	0	1
WINTER							
N	6	7	5	4	3	4	2
NNE	4	4	3	2	1	0	0
NE	3	2	2	1	[1] 0	1	2
ENE	3	2	1	1	1	1	0
E	3	2	2	1	1	[1] 0	0
ESE	4	1	2	1	1	0	0
SE	5	3	2	1	1	[1] 0	2
SSE	8	6	3	2	0	0	0
S	10	12	8	4	1	2	0
SSW	8	9	9	7	4	1	4
SW	6	6	9	9	6	3	0
WSW	5	7	9	15	14	7	0
W	6	12	14	16	23	27	30
WNW	9	10	13	14	21	24	23
NW	10	9	11	14	14	21	28
NNW	8	8	7	8	9	9	9
Calm	2	[1] 0	[1] 0	0	0	0	0
ANNUAL							
N	6	6	5	5	5	5	5
NNE	4	3	4	3	2	2	3
NE	3	3	2	2	2	2	3
ENE	3	2	2	2	2	1	1
E	3	2	2	2	1	1	1
ESE	4	2	2	2	1	1	1
SE	5	3	3	2	2	1	1
SSE	7	6	4	3	1	1	1
S	10	12	8	5	3	2	1
SSW	10	9	9	7	5	3	3
SW	7	8	9	10	8	6	4
WSW	6	8	10	12	13	9	8
W	6	9	11	15	18	18	20
WNW	7	9	11	12	17	20	18
NW	9	10	10	11	12	19	21
NNW	8	8	8	7	8	9	9
Calm	2	[1] 0	[1] 0	[1] 0	[1] 0	[1] 0	[1] 0

[1] Less than 0.5 per cent.

TABLE 10.—*Average percentage frequency of free-air winds from different directions*—Continued

GROUP 3

Direction	Surface	Altitude, meters 250	500	1,000	2,000	4,000	6,000
SPRING							
N	5	5	6	6	7	4	5
NNE	5	5	4	5	3	3	5
NE	5	4	4	4	3	1	3
ENE	5	5	5	4	2	1	1
E	5	4	3	3	2	1	0
ESE	4	4	4	3	1	3	3
SE	4	3	2	2	2	[1] 0	1
SSE	6	5	4	4	2	1	0
S	9	9	8	5	3	2	3
SSW	10	12	12	10	7	6	6
SW	9	11	12	12	11	4	4
WSW	7	7	9	10	12	6	8
W	7	9	9	11	13	16	6
WNW	6	6	6	7	12	21	25
NW	5	4	4	7	10	21	20
NNW	5	7	8	6	10	10	10
Calm	3	[1] 0	[1] 0	1	0	0	0
SUMMER							
N	5	6	6	5	8	3	6
NNE	5	6	5	5	5	4	2
NE	5	5	5	7	4	2	2
ENE	5	4	6	6	3	2	0
E	4	5	4	3	3	2	4
ESE	4	4	3	2	2	2	1
SE	5	4	4	3	2	2	2
SSE	5	5	4	3	4	1	6
S	6	4	4	4	2	4	7
SSW	8	7	6	5	4	1	2
SW	10	9	9	8	7	6	5
WSW	10	12	10	12	11	5	9
W	8	11	14	15	10	14	12
WNW	6	7	8	10	15	17	17
NW	5	5	6	5	12	23	20
NNW	5	6	6	7	8	12	5
Calm	4	[1] 0	[1] 0	0	[1] 0	[1] 0	0
AUTUMN							
N	3	4	4	5	4	2	7
NNE	3	3	3	2	3	3	1
NE	4	4	3	4	3	1	2
ENE	4	2	2	2	[1] 0	1	1
E	3	3	4	3	2	1	0
ESE	4	3	3	2	1	[1] 0	0
SE	6	6	4	2	1	1	0
SSE	7	6	5	3	2	1	0
S	8	9	7	5	4	5	3
SSW	10	10	10	8	8	5	5
SW	11	12	11	13	11	9	8
WSW	9	9	13	13	14	14	9
W	7	11	12	16	16	19	20
WNW	6	7	7	9	16	19	24
NW	5	6	7	9	10	14	14
NNW	4	5	5	4	5	5	6
Calm	6	[1] 0	[1] 0	0	0	0	0
WINTER							
N	3	2	4	4	2	2	11
NNE	4	4	4	3	2	2	3
NE	4	3	3	4	2	1	3
ENE	4	4	3	2	[1] 0	1	0
E	5	5	4	3	2	0	0
ESE	4	3	2	2	0	0	0
SE	5	4	4	2	1	0	3
SSE	6	3	3	3	3	0	0
S	8	6	5	2	2	3	0
SSW	9	8	7	4	3	2	0
SW	9	12	12	12	6	11	0
WSW	9	11	12	11	15	6	14
W	10	11	14	15	17	21	17
WNW	8	11	10	15	24	21	32
NW	5	7	8	12	14	25	14
NNW	4	5	5	6	7	4	3
Calm	3	1	[1] 0	[1] 0	0	1	0
ANNUAL							
N	4	5	5	5	5	3	7
NNE	4	5	4	4	3	3	3
NE	5	4	4	5	3	1	2
ENE	5	4	4	3	1	1	1
E	4	4	4	3	2	1	1
ESE	4	3	3	2	1	1	1
SE	5	4	3	2	1	1	2
SSE	6	5	4	4	3	1	2
S	8	7	6	4	3	4	3
SSW	9	9	9	7	5	3	3
SW	10	11	11	11	9	7	4
WSW	9	10	11	12	13	8	10
W	8	10	12	14	14	17	14
WNW	6	8	8	10	17	20	24
NW	5	5	6	8	12	21	17
NNW	4	6	6	6	8	8	6
Calm	4	[1] 0	[1] 0	[1] 0	[1] 0	[1] 0	0

[1] Less than 0.5 per cent.

TABLE 10.—*Average percentage frequency of free-air winds from different directions*—Continued

GROUP 4

SPRING

Direction	Surface	Altitude, meters 250	500	1,000	2,000	4,000	6,000
N	5	7	8	9	7	8	12
NNE	5	4	5	5	4	3	3
NE	5	4	4	3	3	3	2
ENE	4	3	3	2	2	4	4
E	4	4	2	1	1	[1]0	3
ESE	3	3	3	2	1	1	1
SE	3	3	2	2	1	1	1
SSE	5	5	3	2	1	1	1
S	8	8	6	3	2	2	3
SSW	10	9	8	7	4	2	0
SW	8	9	9	11	6	5	3
WSW	7	7	9	9	12	11	8
W	7	7	9	11	16	18	17
WNW	8	9	10	12	14	17	16
NW	9	10	10	11	15	14	15
NNW	7	8	9	10	11	10	11
Calm	2	[1]0	[1]0	[1]0	0	0	0

SUMMER

Direction	Surface	250	500	1,000	2,000	4,000	6,000
N	6	7	6	7	7	8	8
NNE	6	6	6	6	5	8	6
NE	5	6	6	4	6	3	6
ENE	4	5	5	5	3	2	3
E	3	3	4	3	3	3	1
ESE	3	2	3	2	1	1	1
SE	4	3	2	2	2	1	2
SSE	5	2	2	2	1	1	3
S	8	7	4	3	2	2	5
SSW	10	12	11	5	2	2	3
SW	10	10	9	11	5	6	5
WSW	8	9	11	12	13	14	11
W	6	6	7	12	16	15	22
WNW	5	6	7	9	14	15	14
NW	6	8	9	9	12	9	7
NNW	7	7	8	8	8	10	3
Calm	4	1	[1]0	[1]0	[1]0	0	0

AUTUMN

Direction	Surface	250	500	1,000	2,000	4,000	6,000
N	6	5	6	7	5	3	6
NNE	5	5	4	5	3	3	6
NE	6	5	5	3	3	3	1
ENE	4	4	3	2	2	5	4
E	3	3	2	1	1	1	2
ESE	3	2	3	1	1	1	1
SE	3	2	3	2	1	1	1
SSE	4	3	3	1	[1]0	[1]0	0
S	6	7	4	4	2	[1]0	0
SSW	7	7	7	5	3	1	1
SW	7	7	7	6	5	7	2
WSW	7	6	7	8	11	11	6
W	8	9	9	12	17	20	22
WNW	10	11	12	14	19	19	19
NW	11	14	15	18	17	14	19
NNW	8	10	10	11	10	11	9
Calm	2	0	[1]0	[1]0	[1]0	0	1

WINTER

Direction	Surface	250	500	1,000	2,000	4,000	6,000
N	6	6	5	6	3	3	0
NNE	4	4	3	3	2	2	0
NE	4	4	4	2	2	1	0
ENE	3	3	2	2	1	0	0
E	2	3	1	1	1	[1]0	0
ESE	2	1	2	[1]0	[1]0	[1]0	0
SE	2	1	2	1	[1]0	0	0
SSE	3	2	2	1	[1]0	[1]0	0
S	5	4	3	2	1	0	0
SSW	6	5	4	4	1	1	0
SW	6	6	7	5	4	4	4
WSW	8	8	8	10	13	14	15
W	11	12	12	15	23	24	21
WNW	13	15	18	19	25	25	23
NW	13	17	18	20	17	19	31
NNW	9	9	9	9	7	7	6
Calm	3	[1]0	[1]0	[1]0	0	0	0

ANNUAL

Direction	Surface	250	500	1,000	2,000	4,000	6,000
N	6	6	6	7	6	5	7
NNE	5	5	5	5	3	4	3
NE	5	5	5	3	3	3	2
ENE	4	4	3	3	2	3	3
E	3	3	2	2	2	1	2
ESE	3	2	3	1	1	1	1
SE	3	2	2	1	1	1	1
SSE	4	3	2	1	1	1	1
S	7	6	4	3	2	1	2
SSW	8	8	8	5	2	1	1
SW	8	8	8	8	5	5	3
WSW	7	8	9	10	12	12	10
W	8	9	9	12	18	19	21
WNW	9	11	12	14	18	19	18
NW	10	12	13	15	15	14	18
NNW	8	8	9	10	9	10	7
Calm	2	[1]0	[1]0	[1]0	[1]0	0	[1]0

[1] Less than 0.5 per cent.

TABLE 10.—*Average percentage frequency of free-air winds from different directions*—Continued

GROUP 5

SPRING

Direction	Surface	Altitude, meters 250	500	1,000	2,000	4,000	6,000
N	6	7	7	7	4	5	5
NNE	6	6	6	4	3	1	3
NE	8	6	5	4	2	1	3
ENE	7	7	6	3	2	1	2
E	6	6	4	3	2	3	3
ESE	4	4	3	3	2	2	3
SE	3	3	3	2	2	2	1
SSE	5	4	3	2	1	1	1
S	8	5	6	4	3	[1]0	2
SSW	9	9	9	7	5	3	2
SW	9	13	12	14	7	3	4
WSW	7	8	9	11	14	14	1
W	5	7	8	12	17	21	79
WNW	5	4	6	9	15	20	17
NW	5	5	6	7	13	12	22
NNW	5	6	7	8	8	10	6
Calm	2	[1]0	[1]0	[1]0	[1]0	1	0

SUMMER

Direction	Surface	250	500	1,000	2,000	4,000	6,000
N	4	5	6	6	8	9	9
NNE	5	6	6	7	4	4	5
NE	6	7	7	5	7	2	2
ENE	5	4	4	6	2	2	1
E	5	4	3	3	3	2	0
ESE	4	3	3	2	1	1	0
SE	4	3	3	3	2	2	2
SSE	6	4	3	2	2	[1]0	1
S	9	7	6	3	2	3	1
SSW	12	9	10	7	4	5	5
SW	13	15	11	13	5	9	7
WSW	10	10	12	14	13	8	17
W	6	10	11	11	17	18	20
WNW	4	5	6	7	13	17	15
NW	3	3	4	7	7	11	8
NNW	3	5	5	4	10	7	7
Calm	1	0	[1]0	0	0	[1]0	0

AUTUMN

Direction	Surface	250	500	1,000	2,000	4,000	6,000
N	8	11	10	8	5	7	8
NNE	10	11	10	7	4	7	4
NE	9	11	10	8	5	2	5
ENE	7	6	6	4	3	2	0
E	4	3	5	2	3	1	2
ESE	3	3	1	1	1	1	0
SE	3	3	3	2	1	[1]0	2
SSE	3	3	3	2	1	[1]0	1
S	5	3	3	3	1	1	1
SSW	7	5	5	4	4	3	3
SW	8	9	7	9	7	5	3
WSW	7	8	9	9	11	13	16
W	6	8	8	13	18	19	18
WNW	6	6	7	9	18	21	21
NW	6	5	6	9	11	13	10
NNW	7	5	7	9	7	5	6
Calm	1	[1]0	[1]0	1	[1]0	0	0

WINTER

Direction	Surface	250	500	1,000	2,000	4,000	6,000
N	7	8	7	6	2	1	0
NNE	7	6	6	3	1	0	0
NE	6	7	6	2	[1]0	0	0
ENE	5	5	4	1	[1]0	[1]0	0
E	3	3	3	1	0	0	0
ESE	3	2	2	1	[1]0	1	0
SE	3	3	1	1	1	[1]0	0
SSE	3	3	2	2	[1]0	0	0
S	5	3	4	2	1	0	0
SSW	7	6	5	5	3	0	0
SW	9	9	9	8	7	2	0
WSW	9	10	11	13	15	13	12
W	10	12	13	19	26	32	30
WNW	8	9	10	14	23	27	28
NW	6	8	9	14	16	19	28
NNW	6	6	8	8	5	5	2
Calm	3	0	0	[1]0	0	0	0

ANNUAL

Direction	Surface	250	500	1,000	2,000	4,000	6,000
N	6	8	7	7	5	5	6
NNE	7	7	7	5	3	3	3
NE	7	8	7	5	3	2	2
ENE	6	6	5	3	2	1	1
E	4	4	4	2	2	1	1
ESE	4	3	2	2	1	1	1
SE	3	3	3	2	2	1	1
SSE	4	3	3	2	1	1	1
S	7	5	5	3	2	1	1
SSW	9	7	7	6	4	3	3
SW	10	11	10	11	6	5	4
WSW	8	9	10	12	13	12	13
W	7	9	10	14	19	22	22
WNW	6	6	7	10	17	21	20
NW	5	5	6	9	12	14	16
NNW	5	6	7	7	8	7	5
Calm	2	[1]0	[1]0	[1]0	[1]0	[1]0	0

[1] Less than 0.5 per cent.

TABLE 10.—*Average percentage frequency of free-air winds from different directions*—Continued

GROUP 6

SPRING

Direction	Surface	Altitude, meters 250	500	1,000	2,000	4,000	6,000
N	7	6	6	9	9	8	2
NNE	6	5	5	4	4	1	1
NE	7	6	3	3	4	2	6
ENE	6	5	5	4	2	1	1
E	5	7	5	2	2	1	0
ESE	5	4	5	4	1	1	0
SE	5	5	5	4	3	1	0
SSE	7	7	7	5	2	1	0
S	8	12	11	10	8	1	0
SSW	6	5	7	10	6	4	3
SW	4	4	6	7	9	6	5
WSW	5	4	5	8	9	13	9
W	6	8	6	6	12	17	27
WNW	7	6	6	8	12	17	21
NW	7	8	9	10	9	17	18
NNW	7	8	9	8	8	9	7
Calm	2	[1] 0	[1] 0	[1] 0	0	0	0

SUMMER

Direction	Surface	250	500	1,000	2,000	4,000	6,000
N	3	2	2	4	3	8	4
NNE	4	3	2	2	6	8	5
NE	5	4	3	2	3	3	7
ENE	6	7	7	7	6	3	7
E	6	8	6	6	7	4	2
ESE	5	4	5	6	5	5	2
SE	4	3	3	3	3	3	5
SSE	4	3	3	3	2	2	0
S	6	6	5	3	3	3	2
SSW	8	8	10	8	8	5	2
SW	9	10	7	11	10	9	8
WSW	8	11	13	14	11	10	8
W	6	10	11	12	11	13	18
WNW	5	7	13	9	8	12	11
NW	4	7	6	5	9	6	10
NNW	3	5	4	4	5	6	8
Calm	14	2	[1] 0	1	[1] 0	0	1

AUTUMN

Direction	Surface	250	500	1,000	2,000	4,000	6,000
N	5	6	5	7	3	7	9
NNE	7	8	6	6	3	5	3
NE	11	8	7	6	8	5	3
ENE	10	9	8	7	5	3	4
E	7	13	13	8	3	3	4
ESE	5	6	8	7	6	3	1
SE	4	4	4	6	6	3	2
SSE	4	3	6	6	5	2	2
S	3	4	5	5	3	2	1
SSW	3	6	3	4	4	6	4
SW	3	3	3	5	6	4	7
WSW	4	4	4	4	5	7	10
W	5	5	6	6	13	17	13
WNW	5	6	7	8	16	17	15
NW	5	7	6	9	8	11	12
NNW	5	7	8	6	6	5	9
Calm	14	1	1	[1] 0	0	[1] 0	1

WINTER

Direction	Surface	250	500	1,000	2,000	4,000	6,000
N	7	7	7	8	2	2	1
NNE	6	5	5	4	1	1	3
NE	6	4	3	2	1	0	1
ENE	4	4	3	2	1	[1] 0	0
E	3	4	3	2	1	[1] 0	0
ESE	3	4	3	2	1	1	0
SE	4	3	4	1	2	0	0
SSE	4	4	4	5	1	1	0
S	5	8	7	6	3	1	0
SSW	6	6	7	5	5	3	0
SW	7	7	8	9	7	7	4
WSW	7	7	8	9	10	11	21
W	8	8	8	12	19	25	29
WNW	8	9	10	12	20	30	28
NW	8	9	11	13	18	12	11
NNW	8	10	8	8	8	6	2
Calm	6	1	1	0	0	0	0

ANNUAL

Direction	Surface	250	500	1,000	2,000	4,000	6,000
N	5	5	5	7	5	6	4
NNE	6	5	4	4	3	4	3
NE	7	5	4	3	4	3	4
ENE	7	6	6	5	4	2	3
E	5	8	7	4	3	2	1
ESE	4	5	5	5	3	3	1
SE	4	4	4	4	3	2	2
SSE	5	4	5	5	2	1	1
S	6	8	7	6	4	2	1
SSW	6	6	7	7	6	5	2
SW	6	6	6	8	8	6	6
WSW	6	7	7	8	9	10	12
W	6	8	8	9	14	18	22
WNW	6	7	9	9	14	19	19
NW	6	7	8	9	11	11	13
NNW	6	8	7	7	7	6	6
Calm	9	1	1	[1] 0	[1] 0	0	[1] 0

[1] Less than 0.5 per cent.

TABLE 10.—*Average percentage frequency of free-air winds from different directions*—Continued

GROUP 7

SPRING

Direction	Surface	Altitude, meters 250	500	1,000	2,000	4,000	6,000
N	6	5	8	7	9	10	3
NNE	6	5	5	4	6	4	7
NE	7	5	4	4	7	1	0
ENE	6	5	5	6	7	5	0
E	7	9	11	9	5	2	0
ESE	11	13	11	11	8	1	3
SE	13	17	11	9	6	3	0
SSE	9	7	10	8	5	2	0
S	6	7	7	6	7	5	0
SSW	6	5	4	5	5	7	0
SW	5	4	4	5	5	9	7
WSW	4	4	4	3	6	5	17
W	2	2	3	5	6	10	7
WNW	2	2	2	5	8	10	21
NW	4	5	6	7	4	17	28
NNW	6	5	5	6	6	9	7
Calm	0	0	0	0	0	0	0

SUMMER

Direction	Surface	250	500	1,000	2,000	4,000	6,000
N	4	2	2	4	4	5	6
NNE	4	2	2	3	4	4	0
NE	4	4	2	2	5	2	6
ENE	6	4	5	6	9	6	22
E	9	12	11	13	13	20	6
ESE	12	17	19	12	13	9	12
SE	10	11	10	10	8	9	6
SSE	8	7	6	6	3	9	9
S	8	7	8	5	7	5	6
SSW	8	7	7	6	8	7	6
SW	8	9	9	8	5	5	6
WSW	6	7	7	7	4	7	3
W	4	4	5	9	7	0	0
WNW	3	4	3	4	4	7	6
NW	3	2	2	2	3	0	3
NNW	3	1	2	3	2	5	3
Calm	0	0	0	0	1	0	0

AUTUMN

Direction	Surface	250	500	1,000	2,000	4,000	6,000
N	9	6	7	6	4	6	0
NNE	12	6	5	6	6	3	3
NE	13	11	6	7	9	4	7
ENE	12	16	16	13	9	8	7
E	10	14	15	15	16	7	6
ESE	8	12	12	11	11	4	3
SE	7	8	10	7	5	7	0
SSE	5	4	2	5	2	4	0
S	4	3	4	4	4	6	6
SSW	3	2	3	1	6	5	0
SW	4	5	3	5	2	9	0
WSW	3	2	3	2	5	8	13
W	2	2	3	3	5	10	26
WNW	1	2	3	5	8	10	6
NW	2	3	4	6	6	5	10
NNW	5	4	4	4	2	4	13
Calm	0	0	0	0	0	0	0

WINTER

Direction	Surface	250	500	1,000	2,000	4,000	6,000
N	10	8	6	4	4	3	2
NNE	11	3	5	2	2	2	0
NE	10	9	3	2	2	3	2
ENE	9	11	8	4	4	2	0
E	7	7	11	9	5	1	0
ESE	6	10	7	6	4	0	0
SE	5	6	8	11	5	1	0
SSE	5	7	6	5	5	4	0
S	5	5	4	8	7	5	0
SSW	6	7	7	4	5	8	10
SW	5	4	5	8	7	9	18
WSW	4	4	5	8	12	28	25
W	3	4	4	6	13	14	23
WNW	3	4	6	10	11	13	10
NW	4	5	8	7	8	5	8
NNW	7	6	7	6	6	2	2
Calm	[1] 0	0	[1] 0	0	0	0	0

ANNUAL

Direction	Surface	250	500	1,000	2,000	4,000	6,000
N	7	6	6	5	5	6	3
NNE	8	4	4	4	4	3	3
NE	9	8	4	4	6	2	4
ENE	8	9	8	7	7	5	7
E	8	10	12	12	10	7	3
ESE	10	13	12	10	9	4	5
SE	9	10	10	9	6	5	2
SSE	7	6	6	6	4	5	2
S	6	5	6	6	6	5	3
SSW	6	5	5	4	6	7	4
SW	6	6	5	6	5	8	6
WSW	4	4	5	5	7	12	15
W	2	3	4	6	8	9	14
WNW	2	3	4	6	8	10	11
NW	3	4	5	5	5	7	12
NNW	5	4	4	5	4	5	0
Calm	[1] 0	0	[1] 0	0	[1] 0	0	6

[1] Less than 0.5 per cent.

TABLE 10.—*Average percentage frequency of free-air winds from different directions*—Continued

GROUP 8

Direction	Surface	Altitude, meters 250	500	1,000	2,000	4,000	6,000
SPRING							
N	7	6	6	6	4	3	5
NNE	6	7	5	4	2	1	1
NE	4	6	5	3	1	2	3
ENE	3	3	3	2	1	1	2
E	3	2	3	3	1	1	0
ESE	4	3	2	2	2	[1]0	2
SE	7	5	4	3	2	2	0
SSE	14	9	6	4	3	1	1
S	16	20	18	11	6	4	3
SSW	10	16	19	18	11	6	4
SW	5	7	9	16	17	7	7
WSW	3	3	4	8	14	13	12
W	2	2	3	5	10	19	18
WNW	3	2	2	4	9	15	20
NW	4	4	4	5	10	15	17
NNW	6	5	7	6	7	10	5
Calm	3	[1]0	[1]0	[1]0	0	0	0
SUMMER							
N	6	4	4	4	4	9	10
NNE	6	4	4	2	4	6	5
NE	4	5	5	5	3	6	5
ENE	3	4	3	2	4	6	3
E	3	5	4	4	3	4	2
ESE	4	4	3	3	4	3	3
SE	9	4	5	4	3	5	3
SSE	16	10	8	6	7	4	3
S	18	18	16	15	11	4	3
SSW	12	17	18	18	13	6	4
SW	6	12	13	16	12	6	6
WSW	3	5	7	8	10	5	8
W	2	2	3	3	5	6	6
WNW	1	1	2	4	5	8	10
NW	2	2	2	3	6	12	19
NNW	4	3	3	3	6	10	10
Calm	1	0	0	[1]0	0	0	0
AUTUMN							
N	9	7	6	6	5	5	5
NNE	8	8	7	6	4	2	6
NE	5	6	6	7	3	5	6
ENE	3	2	3	1	2	1	4
E	1	2	2	3	2	1	2
ESE	3	2	1	2	2	1	0
SE	8	4	3	2	2	[1]0	0
SSE	15	12	7	2	3	3	3
S	16	20	18	11	5	3	1
SSW	10	15	18	20	11	5	2
SW	4	6	9	14	13	8	2
WSW	2	3	4	9	12	12	7
W	2	2	4	5	9	17	20
WNW	3	2	2	2	8	19	23
NW	4	4	5	4	10	12	11
NNW	6	5	5	6	9	6	7
Calm	1	[1]0	[1]0	0	0	0	1
WINTER							
N	10	11	9	7	5	4	8
NNE	6	7	7	6	2	2	2
NE	3	3	4	2	1	[1]0	1
ENE	2	3	3	1	[1]0	1	2
E	2	1	1	1	1	[1]0	1
ESE	3	1	1	1	[1]0	1	0
SE	5	2	2	1	1	[1]0	0
SSE	8	4	4	2	1	1	0
S	12	10	6	4	2	2	2
SSW	11	17	16	8	6	2	0
SW	8	11	13	19	14	6	4
WSW	5	5	8	12	16	16	6
W	3	5	5	8	12	20	25
WNW	5	4	5	7	13	22	19
NW	7	8	8	9	15	15	20
NNW	9	8	8	12	11	8	10
Calm	1	[1]0	[1]0	0	[1]0	0	0
ANNUAL							
N	8	7	6	6	4	5	7
NNE	7	7	6	4	3	3	3
NE	4	5	5	4	2	3	4
ENE	3	3	3	2	2	2	3
E	2	2	2	3	2	2	1
ESE	4	2	2	2	2	2	1
SE	7	4	4	3	2	2	1
SSE	13	9	6	4	4	2	2
S	15	17	14	10	6	3	2
SSW	11	16	18	16	10	5	3
SW	6	9	11	16	14	7	5
WSW	3	4	6	9	13	11	8
W	2	3	4	5	9	15	17
WNW	3	2	3	4	9	16	18
NW	4	5	4	5	10	13	17
NNW	6	5	6	7	8	9	8
Calm	2	[1]0	[1]0	[1]0	[1]0	0	[1]0

[1] Less than 0.5 per cent.

TABLE 10.—*Average percentage frequency of free-air winds from different directions*—Continued

GROUP 9

Direction	Surface	Altitude, meters 250	500	1,000	2,000	4,000	6,000
SPRING							
N	6	7	6	5	6	5	4
NNE	6	5	4	4	2	2	1
NE	6	4	4	4	2	2	3
ENE	6	4	4	3	2	[1]0	0
E	6	6	4	3	2	2	2
ESE	8	6	5	4	3	[1]0	0
SE	10	12	11	9	3	2	0
SSE	12	15	15	11	5	2	1
S	11	15	17	16	9	3	2
SSW	7	8	9	10	8	3	1
SW	4	3	4	6	10	6	5
WSW	3	3	3	4	9	12	6
W	2	3	3	5	12	24	30
WNW	3	1	2	4	9	19	22
NW	3	3	3	5	12	14	17
NNW	5	5	6	7	6	4	6
Calm	2	[1]0	[1]0	[1]0	[1]0	[1]0	0
SUMMER							
N	3	2	2	2	3	3	8
NNE	4	2	2	2	3	6	6
NE	5	3	3	2	5	7	7
ENE	5	3	4	3	6	7	11
E	6	5	5	4	6	7	8
ESE	10	9	7	7	5	5	9
SE	12	12	11	9	11	7	4
SSE	11	14	13	14	11	6	6
S	10	16	16	18	12	5	2
SSW	10	13	16	15	11	8	4
SW	8	8	8	11	8	6	3
WSW	5	5	6	4	4	8	6
W	2	2	2	3	5	7	11
WNW	2	2	1	2	3	6	2
NW	2	2	2	2	3	7	7
NNW	2	2	2	2	4	5	9
Calm	3	[1]0	[1]0	[1]0	[1]0	[1]0	0
AUTUMN							
N	8	7	6	7	4	4	5
NNE	9	7	7	7	7	5	6
NE	8	7	8	7	7	6	8
ENE	7	6	6	5	5	7	6
E	7	7	5	4	4	4	0
ESE	9	9	5	4	2	1	1
SE	10	10	9	4	4	3	1
SSE	9	11	14	12	5	3	1
S	8	13	14	14	8	1	2
SSW	6	7	9	11	11	4	3
SW	4	3	4	4	8	9	8
WSW	2	2	1	4	6	10	9
W	2	2	2	5	7	18	20
WNW	3	3	3	2	7	12	14
NW	3	2	3	5	8	8	10
NNW	5	4	4	5	7	5	6
Calm	[1]0	[1]0	[1]0	0	0	0	0
WINTER							
N	9	9	8	10	5	3	4
NNE	7	7	7	5	3	2	6
NE	4	4	4	3	1	4	11
ENE	4	3	4	2	1	1	1
E	4	4	3	1	1	1	0
ESE	5	4	3	1	2	[1]0	0
SE	5	5	4	3	1	1	0
SSE	6	8	7	4	2	1	1
S	8	12	12	8	3	1	0
SSW	8	10	12	13	8	4	2
SW	7	6	7	11	10	6	7
WSW	5	4	5	6	13	15	5
W	4	4	4	6	14	23	29
WNW	6	5	5	8	14	20	11
NW	7	7	7	10	12	11	15
NNW	9	8	8	9	10	7	8
Calm	2	[1]0	[1]0	0	[1]0	0	0
ANNUAL							
N	6	6	6	6	5	4	5
NNE	6	5	5	5	4	4	5
NE	6	4	5	4	4	5	7
ENE	5	4	4	3	3	4	5
E	6	6	4	3	3	3	2
ESE	8	7	5	4	3	2	2
SE	9	10	9	6	5	3	1
SSE	10	12	12	10	6	3	2
S	9	14	15	14	8	2	1
SSW	8	10	11	12	9	5	3
SW	6	5	6	8	9	7	6
WSW	4	3	4	5	8	11	7
W	3	3	3	4	9	18	23
WNW	3	3	3	4	8	14	12
NW	4	4	3	6	9	10	12
NNW	5	4	5	6	7	5	7
Calm	2	[1]0	[1]0	[1]0	[1]0	[1]0	0

[1] Less than 0.5 per cent.

TABLE 11.—*Average percentage frequency of a west component at various levels*

	Surface	Altitude, meters						
		500	1,000	2,000	4,000	6,000	8,000	10,000
GROUP 1								
Spring	50	56	65	76	89	86	80	100
Summer	46	56	68	84	82	90	79	83
Autumn	61	70	78	90	95	89	83	71
Winter	70	78	85	94	94	85	100	75
Annual	56	64	73	86	90	88	83	85
GROUP 2								
Spring	58	70	74	78	79	77	85	75
Summer	60	69	72	75	82	83	74	64
Autumn	65	78	85	90	90	90	91	85
Winter	61	75	80	89	93	94	100	100
Annual	61	73	79	82	85	84	83	74
GROUP 3								
Spring	54	67	70	80	85	81	91	79
Summer	53	64	66	73	83	77	71	64
Autumn	50	69	77	85	89	92	86	80
Winter	60	72	78	89	91	89	88	67
Annual	55	68	73	81	87	84	82	72
GROUP 4								
Spring	64	71	77	83	82	80	72	70
Summer	60	67	71	74	76	72	79	86
Autumn	65	72	79	85	84	81	76	81
Winter	73	79	87	92	94	100	100	100
Annual	66	73	79	84	84	81	77	80
GROUP 5								
Spring	53	62	72	84	84	80	80	80
Summer	57	64	69	71	81	84	90	92
Autumn	53	55	68	79	82	82	71	80
Winter	62	71	93	96	98	100	100	67
Annual	57	63	73	83	85	84	82	83
GROUP 6								
Spring	49	57	65	75	88	92	91	84
Summer	48	67	68	64	66	66	55	60
Autumn	31	42	48	60	70	74	77	79
Winter	58	66	75	89	95	96	96	100
Annual	43	58	65	74	80	80	77	76
GROUP 7								
Spring	36	36	42	48	74	86	100	100
Summer	40	35	43	37	34	36	15	0
Autumn	26	28	32	36	57	74	63	71
Winter	39	46	55	68	84	98	91	86
Annual	36	37	43	48	66	74	69	57
GROUP 8								
Spring	44	59	70	83	87	88	87	81
Summer	40	58	63	65	59	68	67	66
Autumn	35	59	68	76	83	75	63	68
Winter	60	71	80	91	94	89	75	73
Annual	46	62	71	80	81	79	71	71
GROUP 9								
Spring	34	40	43	71	86	92	92	83
Summer	38	42	48	46	52	44	42	21
Autumn	32	36	45	61	69	74	71	86
Winter	48	58	72	84	90	81	61	60
Annual	38	45	55	67	76	73	67	58

TABLE 12.—*Average percentage frequency of a north component at various levels*

	Surface	Altitude, meters						
		500	1,000	2,000	4,000	6,000	8,000	10,000
GROUP 1								
Spring	50	48	47	54	67	66	55	55
Summer	41	41	44	58	77	70	75	83
Autumn	48	50	53	57	62	76	75	71
Winter	56	64	70	73	74	73	82	75
Annual	49	51	53	60	70	71	70	71
GROUP 2								
Spring	47	47	47	56	69	67	70	67
Summer	44	48	52	58	65	64	63	64
Autumn	39	46	48	55	64	68	81	74
Winter	48	54	58	65	75	81	88	50
Annual	45	49	51	58	67	67	70	68
GROUP 3								
Spring	42	43	45	54	69	72	76	84
Summer	37	51	53	61	73	61	57	64
Autumn	34	39	46	49	55	44	79	90
Winter	40	46	55	58	69	80	56	83
Annual	39	44	49	55	66	68	67	77
GROUP 4								
Spring	50	53	58	65	70	77	75	55
Summer	43	53	55	65	65	61	82	57
Autumn	57	61	66	67	68	76	71	81
Winter	60	66	68	70	68	71	69	75
Annual	53	59	62	66	68	72	76	65
GROUP 5								
Spring	47	48	50	55	66	66	64	47
Summer	34	45	49	61	61	58	65	46
Autumn	59	63	61	64	67	62	62	60
Winter	52	57	63	62	66	70	75	100
Annual	49	53	54	60	65	63	65	54
GROUP 6								
Spring	53	48	50	55	66	69	65	84
Summer	36	45	43	49	51	62	73	84
Autumn	54	58	56	56	61	61	60	70
Winter	53	52	56	62	65	61	50	57
Annual	50	51	52	56	61	63	64	76
GROUP 7								
Spring	40	42	47	51	62	72	45	50
Summer	31	26	34	44	41	51	54	57
Autumn	60	55	55	55	47	58	79	86
Winter	58	50	44	45	39	38	41	57
Annual	46	42	45	49	48	53	55	67
GROUP 8								
Spring	36	35	33	40	57	63	56	86
Summer	28	26	25	36	62	67	78	79
Autumn	39	37	37	47	60	71	73	79
Winter	45	47	48	53	64	74	78	67
Annual	37	37	36	44	61	69	73	78
GROUP 9								
Spring	38	33	21	45	58	68	76	54
Summer	26	10	19	33	44	58	58	59
Autumn	46	46	46	58	59	64	77	86
Winter	23	48	51	54	62	74	78	80
Annual	33	37	39	47	57	65	70	62

5. *Frequency of free-air winds of different velocities.*—In Table 13 are given the seasonal and annual frequencies of different velocities without regard to direction. The velocity ranges are 0–9, 10–19, 20–29, 30–39, and 40+ m. p. s., and the altitudes included are surface, 250, 500, 1,000, 2,000, 4,000, and 6,000 meters. At the surface the frequency of winds of 10 m. p. s. or more is very small, averaging from 5 to 10 per cent, with a maximum as a rule in spring and winter. There is no very marked variation in different parts of the country.

A decided increase occurs immediately above the surface, as shown by the figures in the column for 250 meters. At "ordinary flying levels," i. e., 500 to 1,000 meters, winds of 10 m. p. s. or more occur from 20 to 25 per cent of the time in the Southern States and 40 to 45 in the Northern, with a mean of 30 to 35 for the country as a whole. There is a fairly large seasonal range, from about 20 in summer to 45 in winter, the seasonal values as well as the annual being highest in the Northern States. Velocities of 20 m. p. s. or more occur in general at these levels less than 5 per cent of the time.

At greater heights the seasonal and latitudinal variations increase very decidedly, as well as the frequency of the higher velocities themselves. For example, at 4 and 6 kilometers, winds of 10 m. p. s. and more occur in the Northern States (Groups 1 to 4) 45 per cent of the time in summer, 85 in winter, and 65 for the year; in the Southern States except Florida (Groups 5, 6, 8, and 9) the values are 30, 75, and 50, respectively. Winds of 20 m. p. s. or more are observed in the Northern States 5 per cent of the time in summer, 35 to 40 in winter, and 20 for the year; in the Southern States, again excluding Florida, 0, 30, and 15, respectively. In the Florida Peninsula high winds occur so rarely, even at great heights, that they can be ignored so far as their effect on flight is concerned.

The frequencies of different velocities, for the year as a whole. are shown in detail in the frequency curves of Figure 8. The curves for the surface are exceedingly unsymmetrical; at higher levels, where the mean velocity is greater, the skewness becomes noticeably less, but even here there is no very close approach to normal frequency curves.

In general there is close similarity in corresponding curves of the nine groups. Thus, with one exception, the surface curves show the maximum frequency, i. e., the "mode," at 4 m. p. s. This one exception is Group 6, the central Gulf States, where calms and very light winds are frequent. With two exceptions, viz, Groups 7 and 9, the mode is successively displaced to the right with increase in height. This displacement is greater in the Northern than in the Southern States.

The data presented in Table 13 have been classified according to wind direction for certain levels and the results are given in Tables 14 and 15. Table 14 contains annual values for the 500, 1,000, 2,000, and 4,000 meter levels. The velocity ranges are 1–4, 5–9, 10–14, 15–19, 20–29, and 30+ m. p. s. The table thus brings out some of the features shown in Table 13, but in greater detail. In addition, we find that the lowest velocities, 1 to 4 m. p. s., are quite equally distributed as to wind direction. The higher velocities are, however, in general most frequent with westerly directions, except in the Florida Peninsula, Group 7, where the high velocities are more frequent with easterly than with westerly directions, although even here a reversal is noted at the 4-kilometer level. In Groups 8 and 9, southern Plains States, there is a large concentration of the higher velocities around south component winds, particularly S. to SW., at heights up to 2 kilometers, and a swing to northwesterly at greater heights.

The frequency of the higher wind velocities is an important factor in the determination of flight schedules. It is true that winds sufficiently strong to prevent flight altogether seldom occur, owing to the high cruising speed of most aircraft, but it is also true that they materially reduce the ground speed. It is necessary therefore, to make allowance for such winds in adopting a working schedule which can be guaranteed any desired percentage of the time. The values in Table 14 provide the data necessary for this purpose. Their application depends of course upon the orientation of an airway, north-south, east-west or any other direction. Most regular flying is being carried on at about 500 to 1,000 meters above the surface, and the wind velocities for which it is necessary to make allowance in determining workable schedules are those of 10 m. p. s. or more. In order to show the frequencies of these higher velocities more clearly than can be done in a table, Figures 9 and 10 have been prepared, the data being based upon those given in Table 14. An examination of these figures brings out some interesting features, among them the following.

(1) There is a striking similarity in the corresponding curves of the two figures, although in general the actual frequencies are somewhat greater at 1,000 meters than at 500.

(2) In the region between the Rocky Mountains and the Mississippi River, Groups 1, 8 and 9 (see fig. 1 for identification of groups) high velocities are associated with south component winds, particularly in the central section, Group 8, as has been shown by Riley (*9*). In Group 1 they form a secondary maximum, the primary occurring with northwesterly winds.

(3) East of the Mississippi River, with the exception of the Florida Peninsula, SW. to NW. winds are those most frequently accompanied by high velocities, west showing the maximum in Groups 2, 3 and 5, and WNW. to NW. in Groups 4 and 6. In the Florida Peninsula high velocities are most frequent with easterly winds.

(4) A decided variation with latitude is evident. In Groups 6 and 7, for example, high winds are relatively infrequent with any direction and do not therefore constitute a serious factor in planning schedules.

Although aviation must in general furnish year-round service if it is to be a real factor in transportation, yet there will probably be need for some special seasonal services. Again, it may be advisable, even in year-round service, to arrange different schedules for summer and winter. Accordingly, Table 15 has been prepared. It contains data similar to those given in Table 14, but only for the two levels, 500 and 1,000 meters above the surface. Higher levels are not included, partly because the data are hardly sufficient for this refinement of classification, but mostly for the reason that little regular flying is carried on at those heights. From Table 15 curves can readily be made similar to those in Figures 9 and 10.

A study of the values given in Table 15 brings out the same general features as were found in Table 14 and in Figures 9 and 10, and in addition the seasonal variation. This, as we should expect, is more pronounced at the 1,000 than at the 500-meter level. Moreover, at the former the maximum frequency of high winds is very definitely found in winter, whereas at 500 meters there is little difference between winter and spring. (At the surface the maximum occurs in spring; see discussion

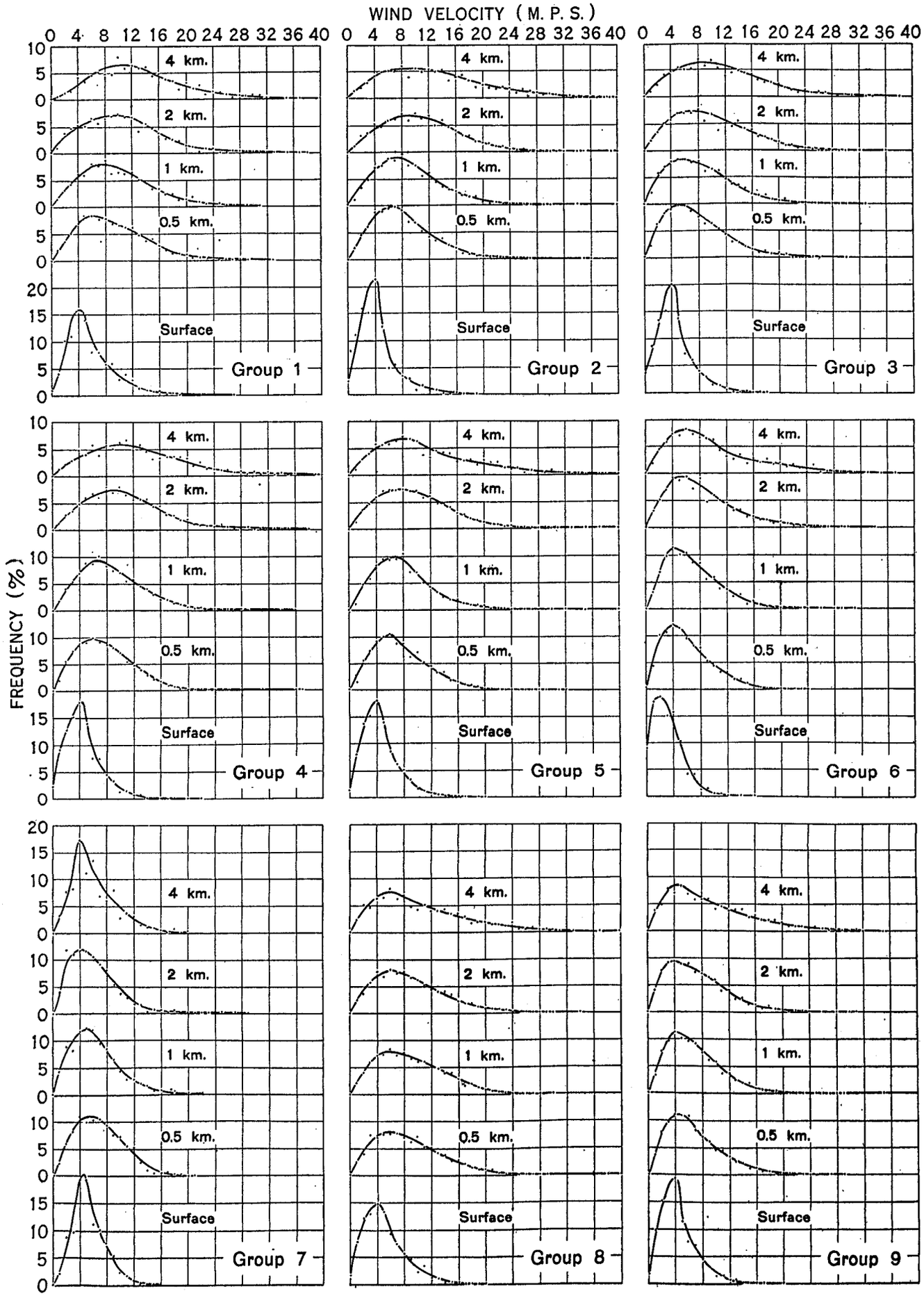

FIG. 8.—Annual frequency distribution of different velocities at selected altitudes in eastern and central United States

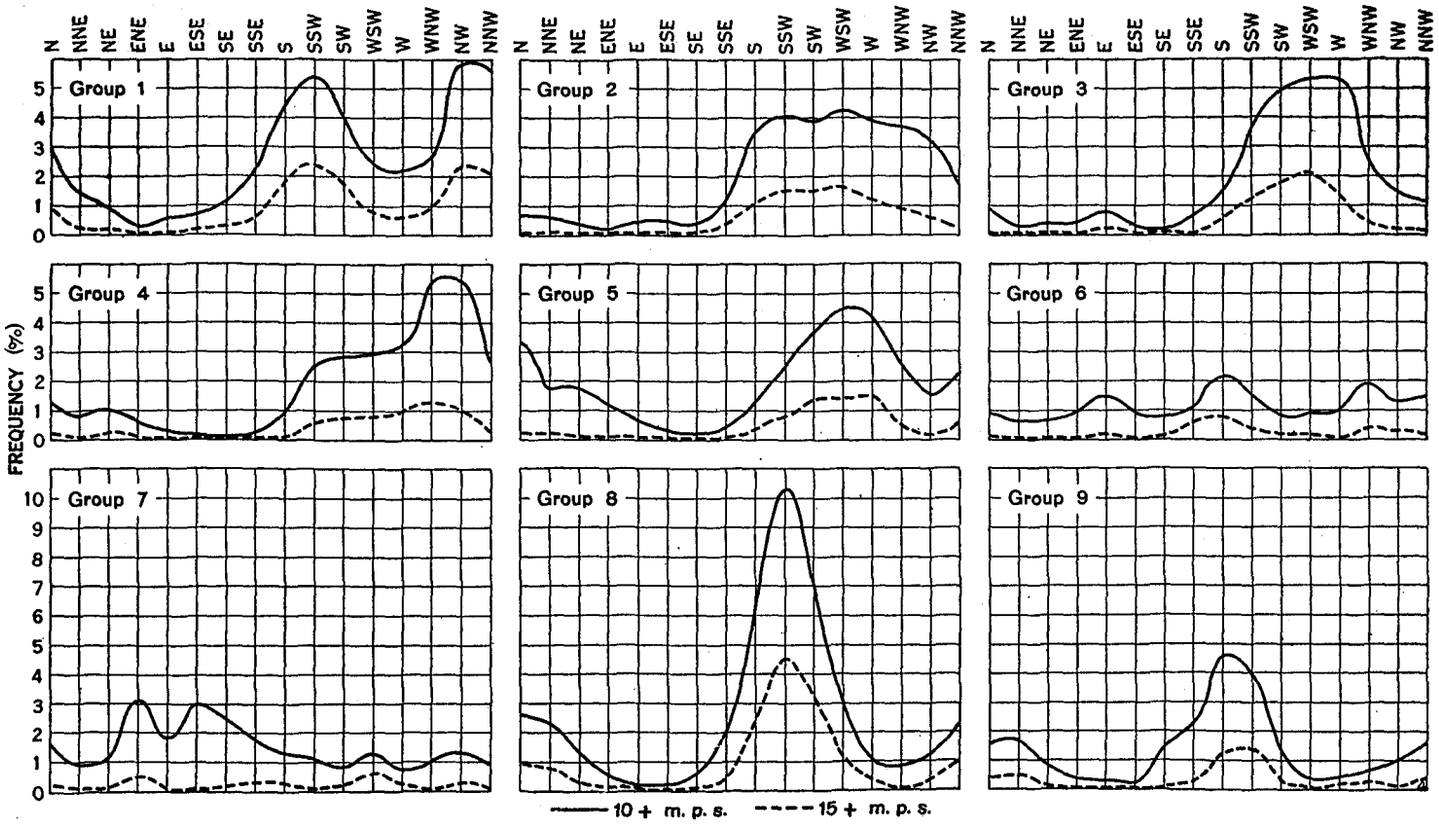

FIG. 9.—Average annual percentage frequency of winds of 10 m. p. s. and over (solid lines) and 15 m. p. s. and over (broken lines) classified by direction, at 500 meters above the surface in eastern and central United States

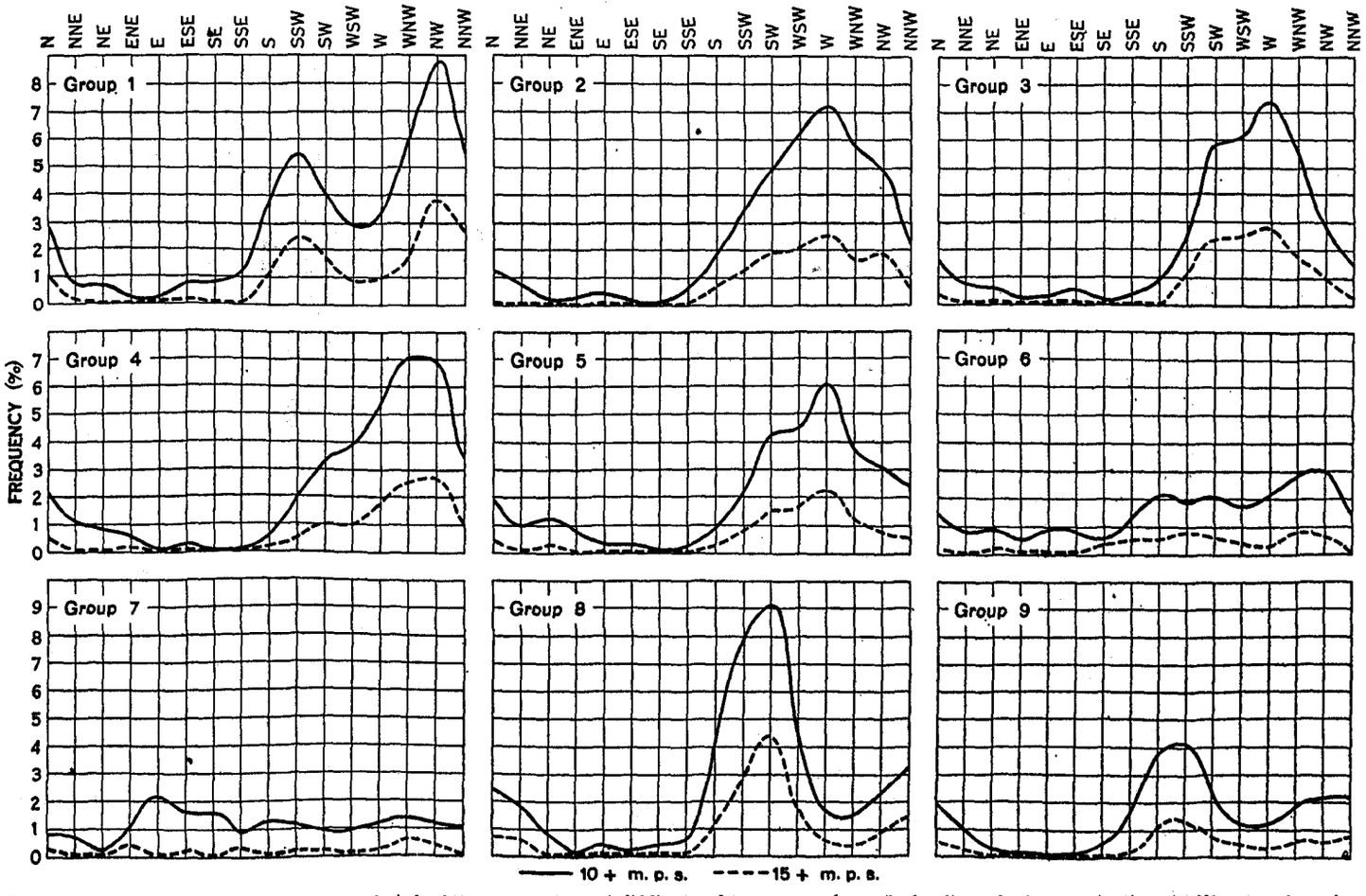

FIG. 10.—Average annual percentage frequency of winds of 10 m. p. s. and over (solid lines) and 15 m. p. s. and over (broken lines) classified by direction, at 1,000 meters above the surface in eastern and central United States

of fig. 2 in section 1.) Summer shows a marked minimum frequency at both levels and in all parts of the country.

The frequencies of different wind directions at various levels, as given in Table 10, have already been discussed in section 4, page 31. From the data used in the preparation of Table 15 it is possible to compute the average velocities for those directions. This has been done, and the results are shown in Figures 11 and 12 for the 500 and 1,000 meter levels respectively. The length of the line representing any direction gives the percentage frequency of that direction, measured by the scale in the lower part of the figure, and the number at the end of a line gives the average velocity of that direction. In general, these figures bring out graphically many of the points already discussed in sections 4 and 5. Attention is again called to the striking similarity in the conditions at the 500 and 1,000 meter levels. This section of the free air might appropriately be termed a "zone of constancy" so far as flight is concerned.

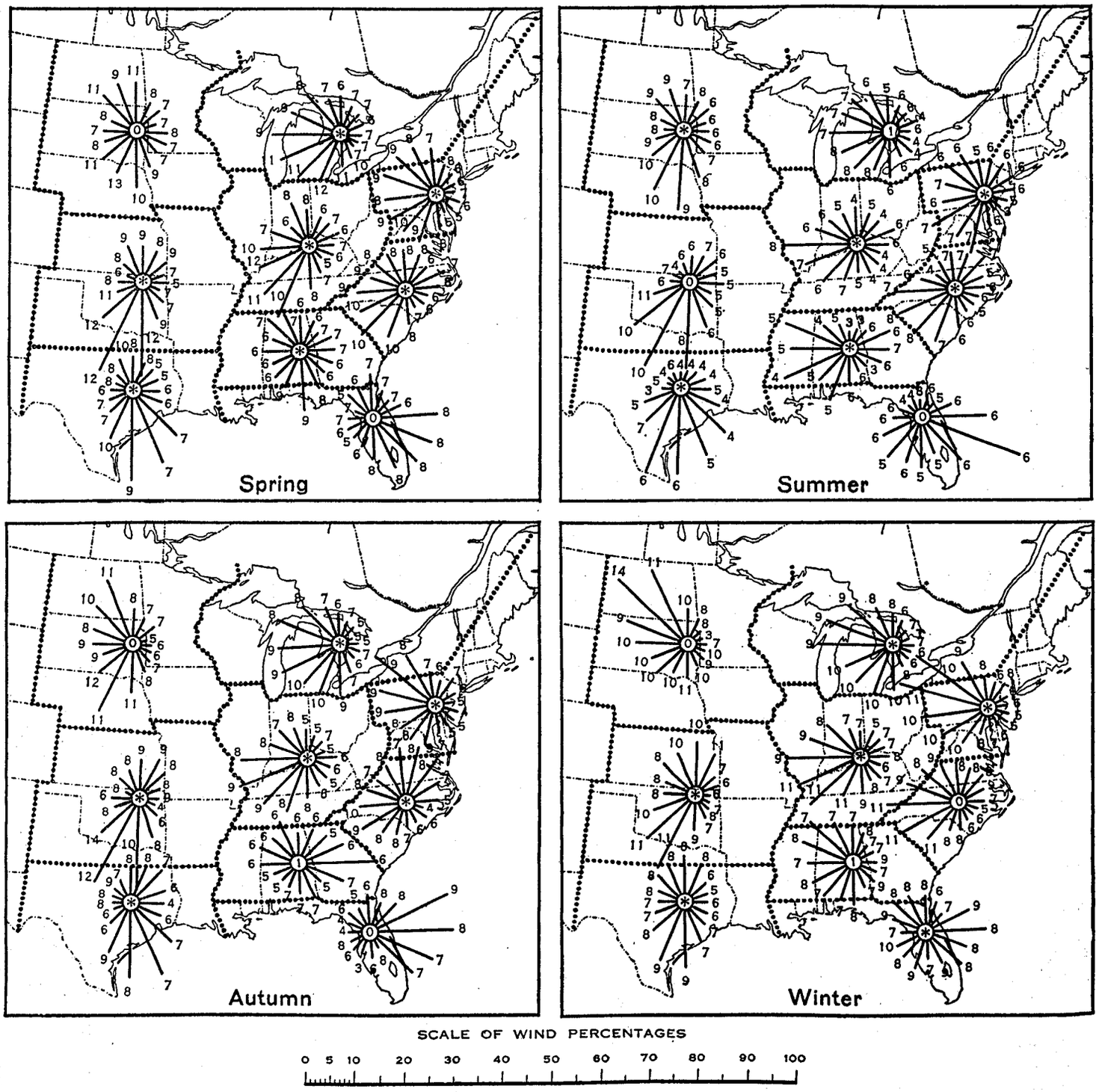

FIG. 11.—Percentage frequency and average velocity of different wind directions at 500 meters above the surface in eastern and central United States. The figure in the center of each circle gives the percentage of calms; an asterisk (*) denotes less than 0.5 of 1 per cent. The length of the lines, measured by the scale in the lower part of the figure, represents the frequency of any given direction on the basis of 100. Figures at or near the ends of the lines give the average velocity of those directions. The line north of the circle represents a north wind, and so on

Table 16 gives the maximum velocities observed at levels up to 6 kilometers during the period under consideration. It is noticeable that nearly all of these occurred with west component winds.

press, based upon one or two experiences in airplane flights, have given to the public the impression that winds of nearly constant westerly direction and of high velocity, "200 or 300 miles per hour," are the rule in

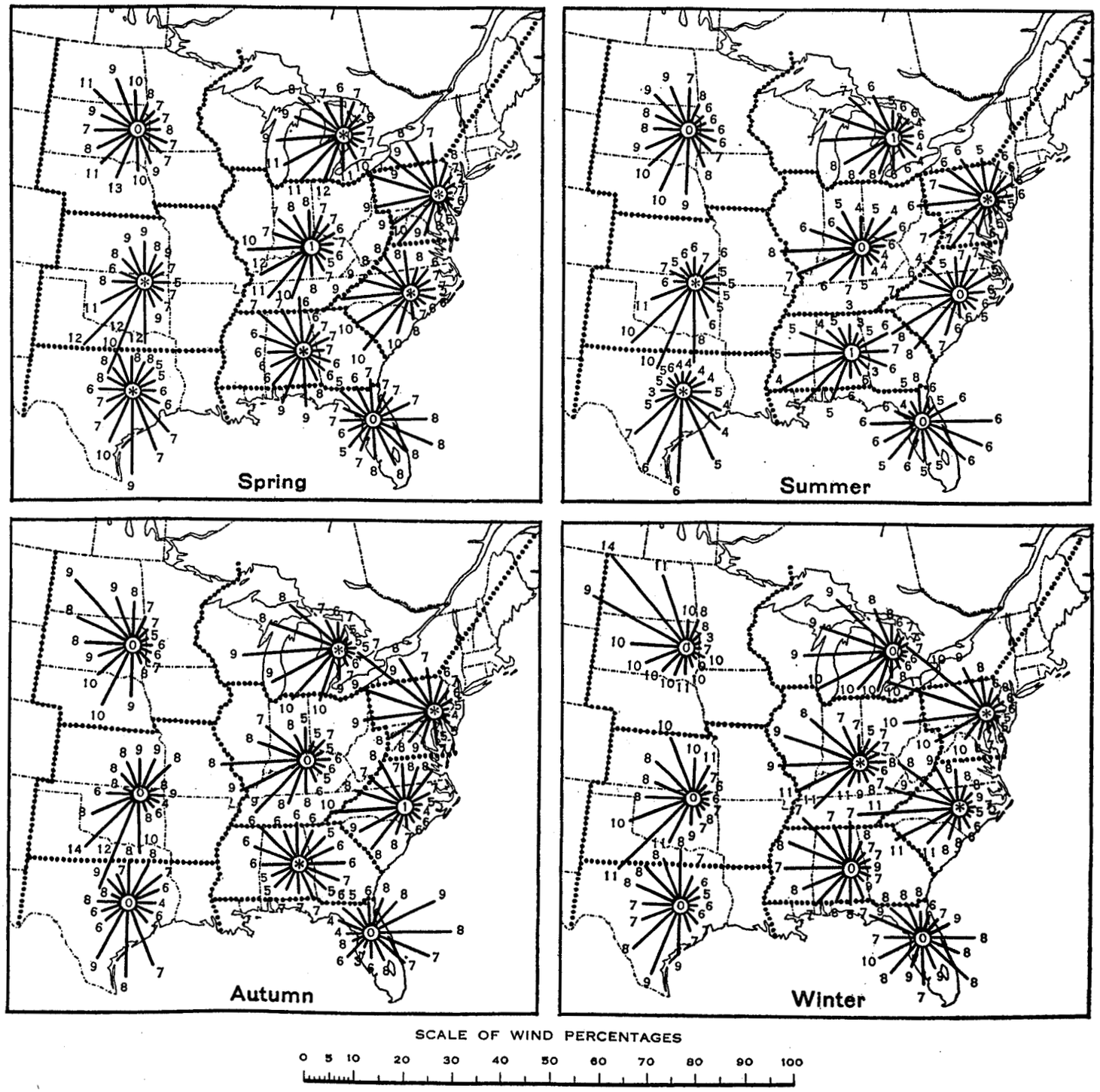

FIG. 12.—Percentage frequency and average velocity of different wind directions at 1,000 meters above the surface in eastern and central United States. (For explanation, see legend under fig. 11)

The highest velocity ever observed at any height is 83 m. p. s. (186 m. p. h.) at 7,200 meters above Lansing, Mich. It is probable that even higher velocities than this occur at times, but they are certainly very infrequent, and, when they do occur, they are probably extremely short-lived. Unfortunately, reports in the

the upper flying levels, 5 to 10 kilometers. Actual observations extending over a period of 8 years, some 140,000 in all, show conclusively that winds of these velocities very rarely, if ever, occur. As for the direction, although in general it has a west component, yet it varies widely from day to day, usually between NNW. and

SSW., but occasionally coming from an easterly point, as shown in previous tables and figures. By no legitimate stretch of the imagination can the wind at any height over the United States be described as "a trade wind of 200 to 300 miles per hour from the west."

TABLE 13.—*Average percentage frequency of free-air winds of different velocities*

GROUP 1

SPRING

Wind velocity, m. p. s.	Surface	Altitude, meters					
		250	500	1,000	2,000	4,000	6,000
0–9	98	65	59	56	54	37	29
10–19	2	34	38	40	40	47	53
20–29	[1] 0	1	3	4	6	15	13
30–39	0	0	0	[1] 0	[1] 0	1	5
40+	0	0	0	0	0	0	0

SUMMER

0–9	89	72	65	66	67	51	42
10–19	11	28	33	31	29	43	47
20–29	0	[1] 0	2	3	4	6	11
30–39	0	0	0	0	0	0	0
40+	0	0	0	0	0	0	0

AUTUMN

0–9	87	65	55	51	41	18	17
10–19	13	34	41	45	54	57	55
20–29	[1] 0	1	4	5	5	20	24
30–39	0	[1] 0	[1] 0	0	[1] 0	5	2
40+	0	0	0	0	0	0	2

WINTER

0–9	84	63	49	38	27	15	23
10–19	16	36	45	52	58	57	50
20–29	0	1	6	9	14	22	12
30–39	0	[1] 0	[1] 0	1	1	5	7
40+	0	0	0	0	0	1	8

ANNUAL

0–9	90	66	57	53	47	30	28
10–19	10	33	39	42	46	51	51
20–29	[1] 0	1	4	5	7	16	15
30–39	0	[1] 0	[1] 0	[1] 0	[1] 0	3	4
40+	0	0	0	0	0	[1] 0	2

GROUP 2

SPRING

0–9	91	70	61	57	44	37	36
10–19	9	29	36	39	47	49	45
20–29	0	1	3	4	8	11	15
30–39	0	0	[1] 0	[1] 0	1	3	3
40+	0	0	0	0	[1] 0	[1] 0	1

SUMMER

0–9	99	87	79	74	63	56	55
10–19	1	13	20	26	35	38	38
20–29	0	[1] 0	1	[1] 0	2	6	6
30–39	0	0	0	0	0	[1] 0	1
40+	0	0	0	0	0	0	0

AUTUMN

0–9	97	77	65	56	39	35	38
10–19	3	23	34	41	52	43	40
20–29	0	[1] 0	1	3	8	19	17
30–39	0	0	0	[1] 0	1	2	5
40+	0	0	0	0	0	1	[1] 0

[1] Less than 0.5 per cent.

TABLE 13.—*Average percentage frequency of free-air winds of different velocities*—Continued

GROUP 2—Continued

WINTER

Wind velocity, m. p. s.	Surface	Altitude, meters					
		250	500	1,000	2,000	4,000	6,000
0–9	94	73	61	49	27	15	13
10–19	6	27	35	46	61	45	36
20–29	0	0	4	4	11	33	34
30–39	0	0	0	1	1	5	8
40+	0	0	0	0	0	2	9

ANNUAL

0–9	95	77	67	59	43	36	36
10–19	5	23	31	38	49	44	40
20–29	0	[1] 0	2	3	7	17	18
30–39	0	0	[1] 0	[1] 0	1	2	4
40+	0	0	0	0	[1] 0	1	2

GROUP 3

SPRING

0–9	93	72	63	60	52	43	37
10–19	7	27	35	36	41	44	44
20–29	0	1	2	4	7	12	16
30–39	0	0	0	[1] 0	[1] 0	1	3
40+	0	0	0	0	0	0	0

SUMMER

0–9	99	92	84	81	73	64	66
10–19	1	8	16	19	26	34	29
20–29	0	0	[1] 0	0	1	2	5
30–39	0	0	0	0	0	0	0
40+	0	0	0	0	0	0	0

AUTUMN

0–9	98	82	71	66	51	36	31
10–19	2	18	28	32	44	34	56
20–29	0	0	1	2	4	12	11
30–39	0	0	0	0	1	2	1
40+	0	0	0	0	0	[1] 0	1

WINTER

0–9	95	75	61	43	31	25	14
10–19	5	25	36	50	55	50	55
20–29	0	[1] 0	3	7	13	19	25
30–39	0	0	[1] 0	[1] 0	1	5	6
40+	0	0	0	0	0	1	0

ANNUAL

0–9	96	80	70	63	52	42	37
10–19	4	20	29	34	42	45	46
20–29	0	[1] 0	1	3	6	11	14
30–39	0	0	[1] 0	[1] 0	[1] 0	2	3
40+	0	0	0	0	0	[1] 0	[1] 0

GROUP 4

SPRING

0–9	94	82	68	60	47	39	41
10–19	6	18	30	38	46	49	46
20–29	0	0	2	2	7	10	11
30–39	0	0	[1] 0	[1] 0	[1] 0	2	2
40+	0	0	0	[1] 0	0	[1] 0	0

SUMMER

80–9	99	94	84	79	68	55	54
010–19	1	6	16	21	31	43	43
720–29	0	0	[1] 0	[1] 0	1	2	3
530–39	0	0	0	0	0	0	0
040+	0	0	0	0	0	0	0

[1] Less than 05. per cent.

TABLE 13.—*Average percentage frequency of free-air winds of different velocities*—Continued

GROUP 4—Continued

AUTUMN

Wind velocity, m. p. s.	Surface	Altitude, meters					
		250	500	1,000	2,000	4,000	6,000
0-9	95	82	68	65	48	35	35
10-19	5	18	31	33	48	48	50
20-29	[1] 0	[1] 0	1	2	4	16	11
30-39	0	0	0	[1] 0	0	1	4
40+	0	0	0	0	0	0	0

WINTER

Wind velocity, m. p. s.	Surface	250	500	1,000	2,000	4,000	6,000
0-9	93	75	55	42	21	15	8
10-19	7	25	43	52	63	43	34
20-29	[1] 0	[1] 0	2	6	15	31	37
30-39	0	0	0	[1] 0	1	10	15
40+	0	0	0	0	0	1	6

ANNUAL

Wind velocity, m. p. s.	Surface	250	500	1,000	2,000	4,000	6,000
0-9	95	83	69	62	46	36	35
10-19	5	17	30	36	47	46	43
20-29	[1] 0	[1] 0	1	2	7	15	16
30-39	0	0	[1] 0	[1] 0	[1] 0	3	5
40+	0	0	0	[1] 0	0	[1] 0	1

GROUP 5

SPRING

Wind velocity, m. p. s.	Surface	250	500	1,000	2,000	4,000	6,000
0-9	88	77	64	64	51	46	47
10-19	12	23	34	33	44	38	46
20-29	[1] 0	[1] 0	2	3	5	13	7
30-39	0	0	[1] 0	[1] 0	[1] 0	3	0
40+	0	0	0	[1] 0	0	[1] 0	0

SUMMER

Wind velocity, m. p. s.	Surface	250	500	1,000	2,000	4,000	6,000
0-9	98	89	79	80	71	70	69
10-19	2	11	21	20	28	27	30
20-29	0	[1] 0	[1] 0	[1] 0	1	3	1
30-39	0	0	0	0	[1] 0	0	0
40+	0	0	0	0	0	0	0

AUTUMN

Wind velocity, m. p. s.	Surface	250	500	1,000	2,000	4,000	6,000
0-9	94	80	69	73	61	55	54
10-19	6	20	30	25	37	34	35
20-29	0	0	1	2	2	10	11
30-39	0	0	0	0	[1] 0	[1] 0	0
40+	0	0	0	0	0	1	0

WINTER

Wind velocity, m. p. s.	Surface	250	500	1,000	2,000	4,000	6,000
0-9	93	73	59	45	25	14	19
10-19	7	27	38	48	60	48	30
20-29	0	[1] 0	3	7	13	29	39
30-39	0	0	0	[1] 0	2	9	12
40+	0	0	0	0	[1] 0	[1] 0	0

ANNUAL

Wind velocity, m. p. s.	Surface	250	500	1,000	2,000	4,000	6,000
0-9	93	80	68	67	52	46	47
10-19	7	20	31	30	42	37	35
20-29	[1] 0	[1] 0	1	3	5	14	15
30-39	0	0	[1] 0	[1] 0	1	3	3
40+	0	0	0	[1] 0	[1] 0	[1] 0	0

GROUP 6

SPRING

Wind velocity, m. p. s.	Surface	250	500	1,000	2,000	4,000	6,000
0-9	95	87	76	72	57	43	33
10-19	5	13	23	27	39	46	50
20-29	0	[1] 0	1	1	4	11	15
30-39	0	0	0	0	0	0	2
40+	0	0	0	0	0	0	0

[1] Less than 0.5 per cent.

TABLE 13—*Average percentage frequency of free-air winds of different velocities*—Continued

GROUP 6—Continued

SUMMER

Wind velocity, m. p. s.	Surface	Altitude, metees					
		250	500	1,000	2,000	4,000	6,000
0-9	100	98	90	88	83	88	85
10-19	[1] 0	2	10	12	17	11	15
20-29	0	0	0	0	[1] 0	1	0
30-39	0	0	0	0	0	0	0
40+	0	0	0	0	0	0	0

AUTUMN

Wind velocity, m. p. s.	Surface	250	500	1,000	2,000	4,000	6,000
0-9	98	92	85	81	77	65	56
10-19	2	8	15	18	20	29	35
20-29	0	0	0	1	3	6	8
30-39	0	0	0	0	0	0	1
40+	0	0	0	0	0	0	0

WINTER

Wind velocity, m. p. s.	Surface	250	500	1,000	2,000	4,000	6,000
0-9	98	87	73	60	43	30	29
10-19	2	13	26	38	48	41	42
20-29	0	0	1	2	9	23	21
30-39	0	0	0	[1] 0	[1] 0	5	4
40+	0	0	0	0	0	1	4

ANNUAL

Wind velocity, m. p. s.	Surface	250	500	1,000	2,000	4,000	6,000
0-9	98	91	81	75	65	57	51
10-19	2	9	19	24	31	32	35
20-29	0	[1] 0	0	1	4	10	11
30-39	0	0	0	[1] 0	[1] 0	1	2
40+	0	0	0	0	0	[1] 0	1

GROUP 7

SPRING

Wind velocity, m. p. s.	Surface	250	500	1,000	2,000	4,000	6,000
0-9	92	94	73	80	81	83	55
10-19	8	6	27	20	19	16	45
20-29	0	0	0	[1] 0	[1] 0	1	0
30-39	0	0	0	0	0	0	0
40+	0	0	0	0	0	0	0

SUMMER

Wind velocity, m. p. s.	Surface	250	500	1,000	2,000	4,000	6,000
0-9	96	92	91	89	95	98	100
10-19	4	8	9	11	5	2	0
20-29	0	0	0	0	0	0	0
30-39	0	0	0	0	0	0	0
40+	0	0	0	0	0	0	0

AUTUMN

Wind velocity, m. p. s.	Surface	250	500	1,000	2,000	4,000	6,000
0-9	96	86	74	87	90	87	71
10-19	4	14	26	13	10	13	29
20-29	0	0	0	0	0	0	0
30-39	0	0	0	0	0	0	0
40+	0	0	0	0	0	0	0

WINTER

Wind velocity, m. p. s.	Surface	250	500	1,000	2,000	4,000	6,000
0-9	93	76	65	71	74	65	42
10-19	6	24	34	28	21	33	50
20-29	1	0	1	1	5	2	8
30-39	0	0	0	0	0	0	0
40+	0	0	0	0	0	0	0

ANNUAL

Wind velocity, m. p. s.	Surface	250	500	1,000	2,000	4,000	6,000
0-9	94	87	76	82	85	83	67
10-19	6	13	24	18	14	16	31
20-29	[1] 0	0	[1] 0	[1] 0	1	1	2
30-39	0	0	0	0	0	0	0
40+	0	0	0	0	0	0	0

[1] Less than 0.5 per cent.

TABLE 13.—*Average percentage frequency of free-air winds of different velocities*—Continued

GROUP 8

Wind velocity, m. p. s.	Surface	Altitude, meters					
		250	500	1,000	2,000	4,000	6,000
SPRING							
0–9	82	61	51	55	52	37	35
10–19	18	38	43	40	45	50	40
20–29	[1] 0	1	6	5	3	12	17
30–39	0	0	[1] 0	[1] 0	0	1	7
40+	0	0	0	0	0	[1] 0	1
SUMMER							
0–9	98	93	68	76	86	83	79
10–19	2	7	30	23	13	17	21
20–29	0	0	2	1	1	[1] 0	0
30–39	0	0	0	[1] 0	[1] 0	0	0
40+	0	0	0	0	0	0	0
AUTUMN							
0–9	92	64	56	56	62	59	52
10–19	8	36	39	42	34	33	36
20–29	0	[1] 0	5	2	4	8	11
30–39	0	0	0	0	0	0	1
40+	0	0	0	0	0	0	0
WINTER							
0–9	88	69	57	44	35	24	34
10–19	12	30	37	50	54	47	32
20–29	0	1	6	6	11	25	22
30–39	0	0	0	0	[1] 0	4	11
40+	0	0	0	0	0	[1] 0	1
ANNUAL							
0–9	90	72	58	58	59	51	50
10–19	10	28	37	39	36	37	32
20–29	[1] 0	[1] 0	5	3	5	11	13
30–39	0	0	[1] 0	[1] 0	[1] 0	1	5
40+	0	0	0	0	0	[1] 0	[1] 0

[1] Less than 0.5 per cent.

TABLE 13.—*Average percentage frequency of free-air winds of different velocities*—Continued

GROUP 9

Wind velocity, in. p. s.	Surface	Altitude, meters					
		250	500	1,000	2,000	4,000	6,000
SPRING							
0–9	90	77	71	72	65	45	41
10–19	10	23	27	27	32	44	42
20–29	0	[1] 0	2	1	3	11	15
30–39	0	0	0	[1] 0	[1] 0	[1] 0	2
40+	0	0	0	0	0	0	0
SUMMER							
0–9	99	94	91	93	92	91	84
10–19	1	6	9	7	8	9	16
20–29	0	0	0	[1] 0	0	[1] 0	0
30–39	0	0	0	0	0	0	0
40+	0	0	0	0	0	0	0
AUTUMN							
0–9	97	81	74	74	72	60	45
10–19	3	19	25	25	25	33	42
20–29	0	[1] 0	1	1	3	6	12
30–39	0	0	0	0	0	1	1
40+	0	0	0	0	0	0	0
WINTER							
0–9	94	79	70	62	52	34	27
10–19	6	21	29	36	43	48	50
20–29	[1] 0	[1] 0	1	2	5	17	19
30–39	0	0	0	0	[1] 0	1	3
40+	0	0	0	0	0	0	1
ANNUAL							
0–9	95	83	77	75	70	58	49
10–19	5	17	22	24	27	33	38
20–29	[1] 0	[1] 0	1	1	3	8	11
30–39	0	0	0	[1] 0	[1] 0	1	2
40+	0	0	0	0	0	0	[1] 0

[1] Less than 0.5 per cent.

TABLE 14.—*Average annual percentage frequency of free-air winds of different velocities at 500, 1,000, 2,000, and 4,000 meters, classified according to wind direction*

GROUP 1

Wind direction	Velocity, m. p. s., 500 m.						Velocity, m. p. s., 1,000 m.						Velocity, m. p. s., 2,000 m.						Velocity, m. p. s., 4,000 m.					
	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	1.3	2.4	2.1	0.7	0.2	[1] 0	0.9	2.1	1.9	0.8	0.2	0	1.0	1.1	1.4	[1] 0	0.3	0	0.6	1.2	0.6	0.7	0.7	0
NNE	1.0	1.7	1.2	0.2	[1] 0	0	1.1	1.3	0.5	0.2	[1] 0	0	1.0	0.6	0.2	0.1	[1] 0	0	0.3	1.2	0.2	0.3	0	0
NE	1.4	1.7	0.7	0.2	[1] 0	0	0.7	1.2	0.6	0.1	[1] 0	0	0.6	0.5	0.2	0	0	0	0.4	0.8	0.2	0	0	0
ENE	0.8	0.9	0.3	[1] 0	0	0	0.6	0.8	0.2	[1] 0	0	0	0.6	0.8	0.1	0.1	0	0	0.3	0.6	0.2	0	0	0
E	0.9	1.3	0.5	0.1	[1] 0	0	0.7	1.0	0.2	0.1	[1] 0	0	0.8	0.5	0.1	0	[1] 0	0	0.3	0	0.3	0	0	0
ESE	1.0	1.6	0.5	0.2	[1] 0	0	0.9	1.2	0.6	0.2	0	0	0.5	0.6	0.1	0	0	0	0.3	0.6	0	0	0	0
SE	1.0	2.0	0.9	0.3	0	0	0.8	1.7	0.7	0.1	0	0	0.8	0.6	0.2	0.2	0	0	0.1	0.3	0	0	0	0
SSE	1.0	2.9	1.7	0.6	0	0	1.1	1.6	1.1	0.1	[1] 0	0	0.7	1.1	0.2	0.2	[1] 0	0	0.5	0.1	0	0	0	0
S	1.3	3.9	2.6	1.4	0.5	0	0.8	3.0	2.6	1.0	0.3	0	0.4	1.4	0.8	0.3	0	0	0	0.7	0.3	0.3	0	0
SSW	0.8	3.3	3.0	1.8	0.6	[1] 0	1.0	3.1	3.0	1.9	0.6	0	1.0	2.3	1.8	1.2	0.3	[1] 0	0.3	0.6	0.5	0.4	0.2	0
SW	1.0	2.8	2.2	1.0	0.7	0	0.8	3.0	2.2	0.9	0.8	[1] 0	1.3	3.5	2.7	0.7	0.5	0	1.2	1.9	2.1	0.6	0.7	0
WSW	0.9	1.8	1.6	0.6	0.2	0	1.0	2.6	2.0	0.6	0.3	[1] 0	1.6	3.2	3.2	0.9	0.3	0	0.7	2.1	3.1	0.8	1.7	0
W	1.2	2.3	1.5	0.7	[1] 0	[1] 0	1.1	3.1	2.3	0.9	0.1	0	1.1	4.0	4.4	2.0	0.5	0	0.6	3.9	7.0	4.2	2.3	0.5
WNW	1.4	2.6	1.7	0.8	0.2	0	1.0	4.2	3.9	1.5	0.3	0	1.1	5.3	6.2	4.4	1.8	0.1	0.8	2.8	7.2	5.7	4.7	1.0
NW	1.4	3.5	3.5	1.6	0.8	0	1.5	4.3	5.0	2.4	1.4	0	1.5	3.5	6.1	4.3	2.0	0.2	0.4	3.9	7.8	3.8	3.6	1.2
NNW	1.2	4.4	3.6	1.5	0.6	0	1.4	3.0	2.8	1.8	0.8	0.1	1.2	2.4	2.9	1.1	0.9	0.2	1.0	2.0	2.7	1.6	1.7	0.4
	Calm 0 [1]						Calm 0						Calm 0.1						Calm 0.2					

[1] Less than 0.05 per cent.

TABLE 14.—*Average annual percentage frequency of free-air winds of different velocities at 500, 1,000, 2,000, and 4,000 meters, classified according to wind direction*—Continued

GROUP 2

Wind direction	Velocity, m. p. s., 500 m.						Velocity, m. p. s., 1,000 m.						Velocity, m. p. s., 2,000 m.						Velocity, m. p. s., 4,000 m.					
	1-4	5-9	10-14	15-19	20-29	30+	1-4	5-9	10-14	15-19	20-29	30+	1-4	5-9	10-14	15-19	20-29	30+	1-4	5-9	10-14	15-19	20-29	30+
N	1.8	2.8	0.7	[1]0	[1]0	0	1.0	2.4	1.1	0.1	0	0	1.1	2.3	1.1	0.3	0	0	0.7	1.5	1.3	1.2	0.4	0
NNE	1.0	1.9	0.5	0.1	0	0	1.0	1.5	0.6	0.1	0	0	0.7	0.8	0.5	0.2	[1]0	0	0.5	1.2	0.7	0.2	0	0
NE	0.8	1.3	0.4	[1]0	[1]0	0	0.9	0.9	0.2	[1]0	0	0	0.9	1.2	0.4	0	0	0	0.6	1.1	0.3	0.2	0.3	0
ENE	1.0	0.8	0.2	[1]0	0	0	0.7	1.0	0.3	[1]0	0	0	0.8	0.7	0.2	0.1	0	0	0.9	0.3	0	0.1	0	0
E	0.8	0.9	0.4	[1]0	0	0	0.4	0.8	0.3	0.1	0	0	0.6	0.5	0.2	0	0	0	0.4	0.3	0	0	0	0
ESE	1.1	0.6	0.4	0.1	0	0	0.7	0.7	0.2	[1]0	0	0	0.6	0.5	0.2	0	0	0	0.1	0.6	0.2	0.1	0	0
SE	1.2	1.0	0.3	0.1	0	0	0.8	1.0	0.1	[1]0	0	0	0.8	0.6	0.2	[1]0	0	0	0.4	0.4	0.2	0.1	0	0
SSE	1.1	2.0	0.8	0.2	0.2	[1]0	0.6	1.3	0.5	0.1	[1]0	[1]0	0.6	0.6	0.2	0	0	0	0.5	0.3	0.2	0	0	0
S	1.5	3.4	2.5	0.8	0.3	0	1.2	2.1	1.3	0.5	0.1	[1]0	0.8	0.9	0.5	0.2	0.1	0	0.5	1.0	0.3	0.2	0.1	0
SSW	1.3	3.5	2.6	1.0	0.5	0	1.3	2.7	2.2	1.1	0.2	[1]0	0.5	2.0	1.7	0.5	0.1	0	0.5	1.3	0.8	0.4	0.1	0.1
SW	1.7	3.2	2.4	1.1	0.4	0	1.0	3.8	3.1	1.4	0.5	[1]0	0.7	2.5	2.9	1.4	0.4	0	0.9	1.9	2.4	0.6	0.4	0
WSW	1.5	4.1	2.7	1.2	0.4	[1]0	1.4	4.5	4.1	1.4	0.7	[1]0	1.3	3.0	5.1	2.1	0.8	0.2	0.8	2.2	2.8	1.4	1.5	0.2
W	2.1	5.2	2.7	1.0	0.2	0	1.5	6.2	4.6	2.1	0.5	[1]0	1.1	4.4	6.1	4.6	1.8	0.1	0.9	2.9	4.4	4.3	4.4	0.9
WNW	1.6	5.0	2.8	0.8	0.1	0	1.3	5.1	4.0	1.5	0.2	0	0.9	3.9	5.2	4.2	2.3	0.1	0.7	3.8	5.2	4.1	5.2	0.6
NW	1.6	5.2	2.7	0.6	0	0	1.3	5.3	3.1	1.4	0.4	0.1	1.0	3.7	4.2	2.4	1.0	0.3	1.4	4.5	5.3	2.8	3.3	0.8
NNW	1.8	3.8	1.6	0.2	0	0	1.4	3.1	1.7	0.5	0.1	[1]0	1.0	2.4	2.9	1.0	0.4	0.2	0.8	2.3	2.4	1.8	1.2	0.2
	Calm 0.2						Calm 0.3						Calm 0.1						Calm 0.1					

GROUP 3

Wind direction	Velocity, m. p. s., 500 m.						Velocity, m. p. s., 1,000 m.						Velocity, m. p. s., 2,000 m.						Velocity, m. p. s., 4,000 m.					
	1-4	5-9	10-14	15-19	20-29	30+	1-4	5-9	10-14	15-19	20-29	30+	1-4	5-9	10-14	15-19	20-29	30+	1-4	5-9	10-14	15-19	20-29	30+
N	1.9	2.2	0.9	[1]0	0	0	1.3	2.2	1.2	0.2	0.1	0	1.3	2.3	1.1	0.5	0	0	0.5	1.3	0.4	0.7	0.	0
NNE	1.8	1.7	0.3	[1]0	0	0	1.3	1.8	0.6	0.1	0	0	0.8	1.6	0.3	0.2	0	0	0.6	0.9	1.2	0.1	0.1	0
NE	1.4	1.9	0.4	[1]0	0	0	1.8	2.3	0.5	0.1	0	0	1.1	1.3	0.3	0	0	0	0.3	0.7	0.3	0	0	0
ENE	1.6	1.8	0.4	[1]0	0	0	1.6	1.4	0.2	[1]0	0	0	0.4	0.5	0.1	0.1	0	0	0.9	0.4	0	0	0	0
E	1.2	1.5	0.6	0.2	[1]0	0	1.1	1.4	0.2	0.1	[1]0	0	0.9	1.0	0.2	0	0	0	0.4	0.6	0	0	0	0
ESE	1.4	1.5	0.2	0.1	0	0	1.3	0.6	0.4	0.1	[1]0	0	0.6	0.5	[1]0	0	0	0	0.5	0.8	0	0	0	0
SE	1.6	1.6	0.1	0.1	0	0	1.1	1.0	0.1	[1]0	0	0	0.4	0.7	0.2	0	0	0	0.7	0.1	0	0	0	0
SSE	1.6	1.7	0.6	0.1	0	0	1.5	1.4	0.4	[1]0	0	0	1.3	1.0	0.4	0.3	0	0	0.3	0.5	0	0	0	0
S	1.6	2.7	1.0	0.5	0.1	0	0.9	2.3	0.8	0.1	[1]0	0	0.9	1.2	0.6	0.1	0	0	1.0	1.5	0.6	0.3	0	0
SSW	1.8	3.2	2.4	0.8	0.4	0	1.5	2.6	1.4	0.7	0.5	[1]0	0.9	2.1	1.8	0.6	0.1	0	0.4	2.0	0.9	0	0	0
SW	2.0	3.9	3.2	1.4	0.3	0	1.8	3.7	3.6	1.6	0.6	0	1.6	3.0	2.2	1.4	0.6	0	0.5	3.4	2.0	1.1	0.3	0
WSW	1.7	4.0	3.2	1.7	0.4	0	1.6	3.7	3.6	1.8	0.7	0	1.1	4.0	4.8	2.3	1.0	0	0.8	1.6	1.8	2.0	1.0	0 4
W	2.0	5.3	3.9	1.3	0.1	[1]0	2.3	4.6	4.6	2.2	0.6	[1]0	1.3	3.8	4.4	3.1	1.4	0.1	1.2	3.8	4.6	4.0	3.8	0.2
WNW	2.0	3.4	2.1	0.4	[1]0	0	1.5	3.2	3.8	1.4	0.3	0	1.4	5.0	4.6	3.8	1.8	0.2	1.0	4.2	6.0	4.5	2.9	1.1
NW	1.6	3.2	1.3	0.2	0	0	1.5	3.9	1.9	0.6	0.4	0	1.6	3.4	3.4	2.4	0.9	0.1	1.8	5.2	6.2	4.4	2.8	0.4
NNW	1.6	3.1	1.0	0.2	0	0	1.5	2.9	1.3	0.2	0	0	1.1	3.4	1.5	1.0	0.4	0	1.8	2.0	2.3	1.2	0.4	0
	Calm 0.4						Calm 0.2						Calm 0.1						Calm 0.3					

GROUP 4

Wind direction	Velocity, m. p. s., 500 m.						Velocity, m. p. s., 1,000 m.						Velocity, m. p. s., 2,000 m.						Velocity, m. p. s., 4,000 m.					
	1-4	5-9	10-14	15-19	20-29	30+	1-4	5-9	10-14	15-19	20-29	30+	1-4	5-9	10-14	15-19	20-29	30+	1-4	5-9	10-14	15-19	20-29	30+
N	2.0	3.0	1.1	0.2	[1]0	0	1.7	3.6	1.6	0.4	0.1	0	0.7	2.6	1.9	0.5	0.1	0	1.0	1.6	2.2	0.4	0.1	0
NNE	1.3	2.5	0.7	0.1	0	0	1.1	2.5	1.0	0.1	0	0	0.8	1.6	0.7	0.1	0.1	0	0.7	1.3	1.4	0.6	0.1	0
NE	1.4	2.4	0.8	0.2	0	0	1.0	1.4	0.7	0.1	0	0	0.8	1.7	0.8	0.2	0	0	0.7	1.0	0.8	0.1	0	0
ENE	1.3	1.5	0.6	[1]0	0	0	0.8	1.4	0.4	0.2	[1]0	0	0.7	1.0	0.4	[1]0	0	0	0.6	0.8	0.8	0.2	0.1	0
E	1.0	1.0	0.3	[1]0	0	0	0.8	0.7	0.1	[1]0	0	0	0.6	0.8	0.2	[1]0	0	0	0.2	0.8	0.2	0	0	0
ESE	1.4	1.0	0.2	[1]0	0	0	0.5	0.6	0.2	0.1	[1]0	0	0.3	0.2	0.1	[1]0	[1]0	0	0.4	0.2	0	0	0	0
SE	1.3	0.9	[1]0	[1]0	0	0	0.7	0.7	[1]0	0	[1]0	0	0.5	0.5	[1]0	0	0	0	0.5	0.1	0	0	0.1	0
SSE	1.0	1.3	0.2	[1]0	0	0	0.5	0.9	0.1	0	[1]0	0	0.3	0.3	0.1	[1]0	0	0	0.4	0.4	0.1	0	0	0
S	1.1	2.2	0.8	0.1	[1]0	0	0.8	1.6	0.4	0.1	0.1	[1]0	0.4	0.6	0.4	0.1	0	0	0.4	0.4	0.2	0	0	0
SSW	1.7	3.4	1.9	0.6	[1]0	[1]0	1.0	2.1	1.5	0.4	0.1	0	0.4	0.9	0.9	0.2	0.1	0	0.5	0.6	0.3	0.1	0	0
SW	1.5	3.7	2.1	0.6	0.1	0	1.3	3.5	2.4	0.8	0.2	0	0.8	1.9	1.4	0.8	0.4	0	1.2	1.4	1.0	1.1	0.4	0.1
WSW	1.6	4.1	2.1	0.7	0.1	0	1.4	4.2	2.9	0.8	0.2	0	0.9	3.9	4.2	2.1	1.0	[1]0	1.3	2.4	3.2	3.7	1.5	0.5
W	1.9	4.2	2.2	0.9	0.1	0	1.4	5.5	3.6	1.5	0.3	0	1.2	5.2	6.5	3.5	1.3	[1]0	0.9	4.3	5.2	3.1	4.7	1.0
WNW	1.5	4.5	4.1	1.2	0.1	[1]0	1.8	4.8	4.5	2.0	0.6	[1]0	1.6	4.5	6.0	4.2	1.8	0.1	1.4	3.9	6.0	3.6	3.1	1.1
NW	2.0	5.3	4.4	0.8	0.2	[1]0	1.5	5.7	4.2	2.2	0.5	[1]0	1.4	4.6	4.5	2.8	1.5	0.2	0.6	2.8	4.0	2.5	3.3	0.6
NNW	2.1	4.2	2.4	0.3	[1]0	0	1.7	4.4	2.4	0.9	0.2	0	0.9	3.2	3.2	1.2	0.3	0	0.8	2.6	2.9	1.9	1.2	0.1
	Calm 0.2						Calm 0.2						Calm 0.1						Calm 0					

GROUP 5

Wind direction	Velocity, m. p. s., 500 m.						Velocity, m. p. s., 1,000 m.						Velocity, m. p. s., 2,000 m.						Velocity, m. p. s., 4,000 m.					
	1-4	5-9	10-14	15-19	20-29	30+	1-4	5-9	10-14	15-19	20-29	30+	1-4	5-9	10-14	15-19	20-29	30+	1-4	5-9	10-14	15-19	20-29	30+
N	1.8	3.8	3.1	0.2	0	0	1.4	3.3	1.5	0.3	0.1	0	1.2	2.1	1.0	0.3	0	0	0.7	2.4	1.7	0.4	0.2	0
NNE	1.5	3.5	1.5	0.2	[1]0	0	1.4	2.9	0.9	0.1	[1]0	0	0.9	1.6	0.4	0.3	0	0.1	1.0	1.4	0.5	0	0	0
NE	1.6	3.4	1.7	0.1	[1]0	0	1.2	2.2	1.0	0.3	[1]0	0	1.3	1.5	0.4	0.2	[1]0	0	0.6	0.5	0.3	0.1	0	0
ENE	1.4	2.3	1.1	0.1	0	0	0.9	1.7	0.8	[1]0	0	0	0.6	0.9	0.6	[1]0	0	0	0.3	0.8	0.4	0	0	0
E	1.2	1.7	0.6	0.1	0	0	0.9	1.2	0.3	[1]0	[1]0	0	0.7	1.0	0.3	0	0	0	0.5	0.8	0.1	0	0	0
ESE	0.9	1.1	0.3	0	0	0	0.7	0.7	0.3	[1]0	0	0	0.3	0.5	0.4	0	0	0	0.4	0.4	0.3	0	0	0
SE	1.0	1.4	0.2	[1]0	0	0	1.0	0.9	0.1	[1]0	0	0	0.7	0.6	0.1	[1]0	0	0	0.4	0.4	0.1	0	0	0
SSE	0.7	1.4	0.4	[1]0	[1]0	0	0.8	1.0	0.3	0	0	0	0.5	0.4	0.2	[1]0	0	0	0.2	0.4	0	0	0	0
S	1.4	2.1	0.9	0.3	0.1	0	1.0	1.4	0.6	0.3	[1]0	0	0.7	0.5	0.3	[1]0	0	0	0.4	0.6	0	0	0	0
SSW	1.6	3.1	1.7	0.6	0.2	0	1.2	2.7	1.4	0.5	0.2	0.1	0.9	1.5	1.0	0.4	0.1	[1]0	1.2	1.1	0.6	0.1	0	0
SW	1.7	4.2	2.3	0.9	0.5	0	1.6	5.0	2.8	0.8	0.7	[1]0	0.7	2.6	2.0	0.6	0.4	[1]0	1.0	2.2	0.8	0.4	0.3	0
WSW	1.5	4.0	3.1	1.1	0.3	0	1.8	5.2	2.7	1.0	0.6	0.1	1.3	4.2	4.2	2.4	1.3	0	1.1	2.8	3.9	2.3	1.2	0.5
W	1.7	3.6	2.7	1.2	0.3	[1]0	2.0	5.5	3.8	1.5	0.8	0	2.0	6.3	5.7	3.1	1.6	0.2	1.8	6.2	4.6	4.8	4.0	1.0
WNW	1.4	3.0	2.1	0.5	[1]0	0	1.5	4.4	2.4	1.1	0.2	0	2.0	5.5	6.1	2.8	0.6	0.1	1.5	5.7	4.5	3.1	5.3	1.2
NW	1.5	2.8	1.3	0.2	[1]0	[1]0	1.9	4.3	2.3	0.6	0.2	0	0.9	4.3	3.6	1.8	1.0	0.2	1.8	3.9	3.6	1.8	2.2	0.5
NNW	1.7	3.7	1.5	0.6	[1]0	0	1.4	3.3	1.9	0.6	[1]0	0	1.0	2.9	2.7	1.0	0.1	[1]0	1.3	2.2	1.2	1.0	0.7	0.1
	Calm 0.1						Calm 0.2						Calm 0.1						Calm 0.2					

[1] Less than 0.05 per cent.

TABLE 14.—*Average annual percentage frequency of free-air winds of different velocities at 500, 1,000, 2,000, and 4,000 meters, classified according to wind direction*—Continued

GROUP 6

Wind direction	Velocity, m. p. s., 500 m.						Velocity, m. p. s., 1,000 m.						Velocity, m. p. s., 2,000 m.						Velocity, m. p. s., 4,000 m.					
	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	1.8	2.4	0.8	0.1	0	0	2.1	3.3	1.2	0.2	0	0	1.2	1.7	1.2	0.4	0.1	0	1.4	2.4	1.6	0.6	0.2	0
NNE	1.6	2.3	0.6	0	0	0	1.8	1.2	0.8	[1]0	[1]0	0	1.4	1.4	0.7	0	0	0	0.7	2.7	0.4	0.1	0	0
NE	1.6	1.8	0.6	0.1	0	0	1.4	1.1	0.7	0.2	0	0	1.4	1.9	0.4	[1]0	0.1	0	0.8	1.4	0.4	0	0	0
ENE	2.4	2.5	0.8	0.1	0	0	2.1	2.4	0.4	0.1	0	0	1.3	1.6	0.8	0	0	0	1.2	0.8	0.2	0	0	0
E	2.1	3.1	1.3	0.2	0	0	1.4	2.1	0.8	0.1	0	0	1.5	1.3	0.6	0	0	0	1.0	1.0	0.4	0	0	0
ESE	1.6	2.5	0.9	[1]0	0	0	1.6	2.3	0.7	0.1	0	0	1.1	1.7	0.1	0	0	0	0.8	1.7	0.2	0	0	0
SE	2.0	1.3	0.7	0.1	0	0	1.7	1.6	0.2	0.3	0	0	1.4	1.3	0.6	0	0	0	1.2	0.4	0.1	0	0	0
SSE	1.7	2.1	0.6	0.4	0.1	0	1.5	1.8	0.9	0.4	0.1	0	0.7	1.2	0.4	[1]0	0	0	0.8	0.7	0	0	0	0
S	1.8	2.9	1.4	0.5	0.3	0	1.6	2.0	1.7	0.4	0.1	0	1.2	1.7	1.1	0.2	0.1	0	0.8	0.4	0.6	0	0	0
SSW	2.2	3.0	1.2	0.3	0.1	0	1.7	3.3	1.1	0.6	0.2	0	1.6	2.6	1.4	0.1	0	0	1.3	2.6	0.2	0.2	0.1	0
SW	2.4	2.7	0.6	0.2	[1]0	0	2.3	3.6	1.5	0.5	0.1	0	1.6	3.8	2.0	0.3	0.3	0	1.5	2.7	1.7	0.3	0.1	0
WSW	3.1	3.2	0.7	0.2	[1]0	0	2.9	3.6	1.3	0.3	0.1	0	2.1	3.4	2.2	0.8	0.3	0	1.5	3.6	2.1	1.7	1.4	0
W	3.5	3.2	1.0	[1]0	[1]0	0	2.7	4.0	1.9	0.2	0.1	[1]0	2.1	4.8	3.8	2.0	1.1	[1]0	1.4	6.2	4.2	2.7	3.3	0
WNW	4.0	3.2	1.5	0.3	0.1	0	2.4	4.0	2.0	0.8	[1]0	0	2.4	4.9	3.4	2.0	1.0	0	2.2	5.5	3.6	3.9	3.1	0.1
NW	3.2	3.6	1.0	0.3	0	0	2.2	4.3	2.4	0.5	0.1	0	2.2	3.6	2.5	1.8	0.8	[1]0	1.9	2.7	4.0	1.0	1.5	0.3
NNW	2.6	3.2	1.3	0.2	0	0	2.2	3.0	1.4	[1]0	0	0	1.6	2.9	1.9	0.5	0.2	0	1.8	1.7	1.2	1.0	0.5	0.1
	Calm 0.6						Calm 0.2						Calm 0.1						Calm 0[1]					

GROUP 7

Wind direction	Velocity, m. p. s., 500 m.						Velocity, m. p. s., 1,000 m.						Velocity, m. p. s., 2,000 m.						Velocity, m. p. s., 4,000 m.					
	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	1.7	2.7	1.4	0.2	0	0	1.4	3.1	0.5	0.3	0	0	2.2	1.9	0.9	0.1	0	0	2.5	3.5	0	0	0	0
NNE	1.1	2.3	0.8	0.1	0	0	1.6	1.6	0.6	0.1	0	0	1.7	2.3	0.3	0.2	0	0	1.4	1.6	0	0	0	0
NE	1.0	1.8	1.0	0.1	0	0	1.4	2.1	0.2	0	0	0	3.8	1.8	0.3	0.1	0	0	1.2	0.7	0.5	0	0	0
ENE	1.8	3.4	2.6	0.4	0.1	0	2.5	3.7	0.7	0.4	0	0	2.6	4.2	0.5	0	0	0	2.3	2.4	0.2	0	0	0
E	2.4	6.1	1.8	[1]0	0	0	3.4	5.9	2.1	0.1	0	0	3.8	5.6	0.5	0	0	0	2.2	4.8	0.2	0	0	0
ESE	2.8	6.3	3.0	[1]0	0	0	2.2	6.4	1.4	0.2	0	0	2.7	5.3	0.8	0.2	0	0	2.2	0.9	0.2	0	0	0
SE	2.4	5.0	2.3	0.2	0	0	2.8	4.8	1.6	0	0	0	3.3	3.0	0	0	0	0	2.5	2.6	0	0	0	0
SSE	1.4	3.0	1.5	0.3	0	0	2.4	2.6	0.6	0.3	0	0	2.2	1.4	0.2	0	0	0	1.4	2.7	0.5	0	0	0
S	1.9	2.5	1.0	0.3	0	0	1.6	2.7	1.2	0.1	0	0	2.2	3.2	0.6	0	0	0	2.3	2.1	0.7	0.2	0	0
SSW	1.7	2.7	1.0	0	0.1	0	1.0	2.0	1.0	0.2	0	0	3.5	1.5	0.7	0.2	0	0	2.8	3.2	0.7	0	0	0
SW	2.1	2.4	0.6	0.2	0	0	2.3	3.2	0.7	0.2	0	0	1.8	2.0	0.8	0.1	0	0	2.1	4.4	1.4	0	0.2	0
WSW	1.2	2.5	0.7	0.6	0	0	1.0	3.1	0.8	0	0.1	0	1.4	3.9	1.0	0.4	0	0	3.0	4.3	2.7	2.0	0	0
W	1.7	1.5	0.5	0.2	0	0	2.0	2.6	1.0	0.2	0	0	2.3	3.4	1.2	0.4	0.4	0	2.3	4.2	1.4	0.5	0.5	0
WNW	1.2	1.5	0.9	0	0.1	0	2.2	2.3	0.8	0.4	0.2	0	2.4	2.9	1.6	0.8	0.1	0	3.0	4.6	2.8	0	0	0
NW	1.9	1.9	1.0	0.3	0	0	1.8	2.4	0.8	0.4	0	0	2.1	1.1	1.0	0.4	0.5	0	3.1	2.6	0.7	0.5	0	0
NNW	1.5	2.2	0.8	0.1	0	0	1.4	2.2	1.0	0.1	0	0	1.2	1.9	0.5	0.1	0.3	0	2.8	1.7	0.7	0	0	0
	Calm 0.1						Calm 0						Calm 0.2						Calm 0					

GROUP 8

Wind direction	Velocity, m. p. s., 500 m.						Velocity, m. p. s., 1,000 m.						Velocity, m. p. s., 2,000 m.						Velocity, m. p. s., 4,000 m.					
	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	1.4	2.2	1.7	0.6	0.3	0	1.2	1.9	1.7	0.7	[1]0	0	1.1	1.6	0.7	0.7	0.3	0	1.1	2.4	0.7	0.4	0.2	0.1
NNE	1.0	2.5	1.5	0.6	0.2	0	0.8	1.6	1.2	0.5	0.1	0	0.9	1.2	0.6	0.1	0	0	1.2	1.1	0.6	0.1	0.1	0
NE	1.5	2.0	1.0	0.3	[1]0	0	1.1	2.1	0.9	[1]0	0	0	0.9	0.8	0.3	0.1	0	0	0.9	2.0	0.1	0.2	0	0
ENE	1.1	1.4	0.4	0.2	0	0	0.7	0.8	0.1	0	0	0	1.0	0.6	0.2	0	0	0	1.2	0.9	0	0.1	0	0
E	1.1	1.0	0.2	[1]0	0	0	1.4	0.9	0.3	0.1	0	0	0.9	0.8	[1]0	0	0	0	0.8	0.5	0.2	0	0	0
ESE	0.9	0.8	0.2	[1]0	[1]0	0	1.0	1.0	0.2	[1]0	0	0	1.0	0.7	0.2	0	0	0	0.5	0.9	0	0	0	0
SE	1.4	1.6	0.5	0.1	[1]0	0	1.2	1.0	0.3	0.1	[1]0	0	0.7	1.0	0.2	[1]0	0	0	1.0	0.7	0	0.1	0	0
SSE	1.7	2.6	1.6	0.4	0	0	1.2	1.8	0.6	0.1	0	0	1.3	1.7	0.5	[1]0	0	0	1.0	0.8	0.4	0.1	0	0
S	2.3	5.5	4.2	1.7	0.8	0	1.8	4.4	3.1	0.8	0.3	0	1.5	3.2	1.1	0.3	0.1	0	1.3	1.5	0.4	0	0	0
SSW	1.7	5.8	5.8	2.8	1.7	0	1.7	6.5	5.0	2.2	0.8	[1]0	1.5	4.9	2.5	0.9	0.2	0.1	1.2	2.1	1.2	0.2	0	0
SW	1.2	3.1	3.5	2.1	1.2	0	1.6	5.2	4.8	3.4	1.0	[1]0	1.7	5.0	4.1	2.1	1.1	0	1.0	2.5	2.1	0.7	0.4	0.1
WSW	0.8	1.9	1.8	1.0	0.2	0	1.2	2.9	3.0	1.5	0.4	0	2.1	4.5	3.9	2.1	0.5	0	1.7	3.0	2.9	1.6	1.8	0.2
W	1.4	1.5	0.6	0.3	0.1	0	1.1	2.4	1.1	0.4	0.2	0	1.4	3.6	2.5	1.1	0.4	0	1.3	3.7	3.7	3.9	2.7	0.1
WNW	0.8	1.0	0.9	[1]0	0	0	1.0	1.9	1.1	0.4	[1]0	0	1.7	3.0	2.8	0.9	0.3	[1]0	1.2	4.2	4.5	3.6	2.8	0
NW	1.4	1.8	0.8	0.4	[1]0	0	1.0	1.8	1.5	0.7	0.2	0	1.2	2.8	2.8	2.2	1.3	0	1.6	3.6	3.0	2.3	2.6	0.3
NNW	1.3	1.9	1.3	0.8	0.2	0	1.4	2.2	1.8	1.1	0.3	0	1.7	2.6	2.2	1.2	0.6	[1]0	1.3	2.9	2.4	1.1	0.7	0.2
	Calm 0.2						Calm 0.1						Calm 0[1]						Calm 0					

GROUP 9

Wind direction	Velocity, m. p. s., 500 m.						Velocity, m. p. s., 1,000 m.						Velocity, m. p. s., 2,000 m.						Velocity, m. p. s., 4,000 m.					
	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	1.3	2.7	1.2	0.4	[1]0	0	1.5	2.5	1.4	0.5	0	0	1.7	1.3	1.3	0.2	0.1	0	1.3	1.5	0.5	0.1	0	0.1
NNE	1.6	2.2	1.2	0.4	0.1	0	1.9	1.8	0.8	0.2	[1]0	0	1.8	1.6	0.4	[1]0	0	0	1.6	1.9	0.4	0.1	0	0
NE	1.9	2.1	0.7	0.1	0	0	1.7	2.0	0.3	[1]0	0	0	2.1	1.4	0.4	[1]0	0	0	1.6	2.0	1.0	0.1	0	0
ENE	2.3	1.8	0.3	0.1	0	0	1.9	1.4	0.2	[1]0	0	0	1.7	1.4	0.2	[1]0	0	0	1.7	1.6	0.3	0	0	0
E	2.0	1.8	0.3	[1]0	0	0	2.0	1.2	0.1	[1]0	0	0	1.4	1.2	0.6	[1]0	0	0	1.6	1.8	0	0	0	0
ESE	2.4	2.4	0.2	[1]0	0	0	2.4	1.6	0.2	[1]0	0	0	1.9	0.9	0.1	0	0	0	1.2	0.6	0	0	0	0
SE	3.6	3.6	1.4	0.1	0	0	2.6	2.9	0.5	[1]0	0	0	2.6	2.0	[1]0	[1]0	0	0	1.4	1.4	0.1	0	0	0
SSE	3.9	5.8	2.0	0.3	[1]0	0	3.5	5.1	1.4	0.2	[1]0	0	2.1	2.9	0.7	0	[1]0	0	1.6	1.1	0.4	0	0	0
S	3.8	6.6	3.4	1.0	0.2	0	4.3	5.6	2.7	1.0	0.1	0	2.2	3.9	1.6	0.5	[1]0	0	1.0	1.3	0.1	0.1	0	0
SSW	2.8	4.5	2.6	1.1	0.3	0	2.1	5.9	2.9	1.0	0.3	0	3.0	4.3	1.7	0.4	0.1	0	1.7	2.1	0.6	0.2	0.2	0
SW	1.6	2.6	1.1	0.3	[1]0	0	2.1	3.8	1.5	0.7	0.1	0	2.2	3.6	2.1	0.8	0.2	0	1.5	2.9	1.1	0.7	0.7	0.1
WSW	1.3	1.8	0.4	[1]0	[1]0	0	1.6	1.8	0.8	0.4	[1]0	0	1.4	3.2	2.4	0.6	0.2	[1]0	1.4	3.3	3.0	1.9	1.7	0
W	1.3	1.1	0.3	0.1	0.1	0	1.4	1.6	0.9	0.2	0.1	[1]0	1.4	3.5	2.7	1.1	0.6	0	2.0	4.5	4.3	3.7	2.3	0.3
WNW	0.9	1.2	0.4	0.2	0.1	0	0.9	1.3	1.2	0.4	0.2	0	1.5	3.0	2.1	1.3	0.4	[1]0	1.7	3.4	4.8	3.0	1.7	0.1
NW	1.0	1.4	0.8	0.2	[1]0	0	1.4	2.0	1.5	0.5	0.1	0	1.8	2.9	2.4	1.1	0.6	0	1.6	3.1	2.2	2.0	1.1	0.1
NNW	1.2	2.1	1.1	0.4	0.1	0	1.3	2.1	1.4	0.7	0.1	0	1.7	2.2	1.6	0.8	0.4	0	1.1	1.9	1.4	0.6	0.3	0
	Calm 0.2						Calm 0.1						Calm 0.2						Calm 0.2					

[1] Less than 0.05 per cent.

TABLE 15.—*Average seasonal percentage frequency of free-air winds of different velocities at 500 and 1,000 meters, classified according to wind direction*

GROUP 1

SPRING

Wind direction	Velocity m. p. s., 500 m.						Velocity m. p. s., 1,000 m.					
	1-4	5-9	10-14	15-19	20-29	30+	1-4	5-9	10-14	15-19	20-29	30+
N	1.0	2.7	3.1	1.3	0.4	0	1.0	1.5	2.2	1.3	0	0
NNE	1.0	2.2	1.0	0.3	0	0	1.2	1.3	0.6	0.1	0.1	0
NE	1.2	2.9	1.0	0.1	0	0	0.6	1.9	0.6	0.3	0	0
ENE	0.6	1.9	0.4	0.1	0	0	0.4	1.9	0.4	0.1	0	0
E	0.8	1.9	1.0	0.3	0.1	0	0.4	2.2	0.1	0.3	0.1	0
ESE	1.6	2.7	0.6	0.4	0.1	0	1.3	2.1	0.9	0.4	0	0
SE	1.3	2.6	0.9	0.4	0	0	0.9	2.8	1.2	0.1	0	0
SSE	0.8	3.0	2.7	0.5	0	0	1.6	2.7	1.2	0.4	0.1	0
S	0.4	5.1	3.0	1.3	0.5	0	0.6	2.7	3.3	1.0	0.3	0
SSW	0.4	3.0	2.1	2.2	1.2	0	0.9	3.1	2.7	1.6	0.7	0
SW	1.4	2.5	1.4	0.8	0.7	0	0.9	2.1	2.4	0.9	1.0	0.1
WSW	1.0	1.7	1.7	0.3	0	0	0.9	2.5	2.1	0.6	0.4	0.1
W	1.2	2.1	1.0	0.3	0	0	1.2	3.6	2.2	0.3	0.1	0
WNW	1.0	1.4	1.3	0.5	0	0	0.6	2.8	3.1	0.3	0.1	0
NW	0.8	3.6	2.5	1.9	0.3	0	0.7	4.2	3.3	2.1	0.4	0
NNW	1.3	3.8	2.3	1.0	0.1	0	1.0	4.0	3.1	1.3	0.4	0
	Calm 0						Calm 0					

SUMMER

Wind direction	Velocity m. p. s., 500 m.						Velocity m. p. s., 1,000 m.					
	1-4	5-9	10-14	15-19	20-29	30+	1-4	5-9	10-14	15-19	20-29	30+
N	1.9	2.9	1.0	0.3	0	0	1.2	2.9	2.4	0.3	0	0
NNE	1.3	1.4	1.6	0.2	0.2	0	1.9	1.7	0.7	0	0	0
NE	2.4	1.8	1.1	0	0	0	1.2	1.0	0.7	0.2	0	0
ENE	1.1	1.0	0.5	0	0	0	0.5	0.9	0.2	0	0	0
E	1.4	1.3	0.3	0.2	0	0	1.2	1.2	0.2	0	0	0
ESE	1.9	1.9	0.6	0	0	0	1.5	1.7	0.5	0	0	0
SE	1.4	2.6	1.0	0.5	0	0	1.9	1.9	0.5	0	0	0
SSE	1.9	4.8	1.0	1.1	0	0	2.2	2.2	1.4	0.3	0	0
S	2.9	6.1	3.5	1.6	0.5	0	1.2	5.3	2.9	0.9	0.3	0
SSW	1.3	4.3	4.0	1.6	0.6	0	1.7	4.1	3.8	2.1	0.5	0
SW	1.3	2.7	1.9	1.4	0.2	0	1.5	3.8	2.7	0.3	0.7	0
WSW	1.0	1.4	1.1	0.6	0.2	0	1.5	2.9	1.7	0.5	0.3	0
W	1.1	0.6	0.5	0.5	0	0	0.9	2.7	1.2	0.5	0.3	0
WNW	1.4	0.8	1.0	0.5	0.2	0	0.7	3.3	1.5	0.5	0.3	0
NW	1.3	2.7	1.4	1.1	0.2	0	1.7	3.8	2.1	1.0	0.3	0
NNW	1.1	3.9	2.1	0.3	0.3	0	2.6	3.3	1.4	0.5	0.2	0
	Calm 0.2						Calm 0					

AUTUMN

Wind direction	Velocity m. p. s., 500 m.						Velocity m. p. s., 1,000 m.					
	1-4	5-9	10-14	15-19	20-29	30+	1-4	5-9	10-14	15-19	20-29	30+
N	1.4	2.2	1.2	0.6	0.2	0	1.1	2.5	2.0	0.9	0.5	0
NNE	1.2	1.6	0.9	0.3	0	0	0.9	1.1	0	0.4	0	0
NE	1.4	1.7	0.2	0.3	0.2	0	0.5	1.1	0.7	0	0.2	0
ENE	0.9	0.5	0.2	0	0	0	0.9	0.2	0.2	0	0	0
E	0.9	1.2	0.3	0	0	0	0.9	0.5	0.4	0	0	0
ESE	0.5	1.2	0.2	0	0	0	0.5	0.5	0.5	0	0	0
SE	0.8	1.7	0.8	0.2	0	0	0.4	1.6	0.5	0.2	0	0
SSE	0.9	2.3	1.9	0.3	0	0	0.4	0.7	0.5	0	0	0
S	0.9	3.1	2.3	1.7	0.5	0	1.4	3.0	2.5	1.2	0.5	0
SSW	0.9	5.0	4.7	2.7	0.5	0.2	0.7	4.1	4.5	2.5	1.1	0
SW	0.8	2.2	3.3	1.2	0.8	0	0.2	2.9	2.7	2.1	0.7	0
WSW	1.1	1.7	1.7	0.5	0.2	0	1.1	3.0	1.2	0.7	0	0
W	1.1	2.7	2.2	0.5	0.2	0	1.1	3.4	2.7	1.2	0.2	0
WNW	1.4	3.3	0.9	0.8	0.2	0	1.1	4.5	3.9	1.1	0.2	0
NW	1.7	3.4	3.6	0.8	0.5	0	2.7	4.3	5.6	1.8	1.6	0
NNW	1.2	3.9	4.4	2.7	0.3	0	1.1	2.1	2.9	1.6	0	0
	Calm 0						Calm 0					

WINTER

Wind direction	Velocity m. p. s., 500 m.						Velocity m. p. s., 1,000 m.					
	1-4	5-9	10-14	15-19	20-29	30+	1-4	5-9	10-14	15-19	20-29	30+
N	1.1	2.0	3.2	0.6	0	0.2	0.4	1.4	1.1	0.7	0.2	0
NNE	0.6	1.8	1.2	0	0	0	0.4	1.1	0.9	0.4	0	0
NE	0.6	0.6	0.6	0.2	0	0	0.5	0.9	0.2	0	0	0
ENE	0.8	0.3	0	0	0	0	0.4	0.2	0	0	0	0
E	0.6	0.9	0.5	0	0	0	0.2	0.2	0.2	0	0	0
ESE	0	0.6	0.6	0.2	0	0	0.2	0.7	0.5	0.2	0	0
SE	0.3	1.1	0.8	0.2	0	0	0	0.5	0.5	0	0	0
SSE	0.2	1.4	1.2	0.6	0	0	0.2	0.9	1.2	0	0	0
S	0.9	1.4	1.5	0.9	0.5	0	0.4	1.4	1.4	0.7	0.2	0
SSW	0.8	1.8	1.4	0.9	0.2	0	0.4	1.1	0.9	1.4	0.5	0
SW	0.5	3.4	2.0	0.5	0.5	0	0.7	3.0	0.7	0.4	0.7	0
WSW	0.6	2.3	2.0	0.8	0.3	0	0.4	1.9	2.7	0.7	0.7	0
W	1.2	3.7	2.3	1.1	0	0.2	1.2	2.6	3.2	1.9	0.2	0
WNW	1.8	4.7	3.5	1.4	0.3	0	1.4	6.3	7.2	4.1	0.7	0
NW	1.7	4.4	6.5	2.6	2.3	0	0.9	4.8	8.5	4.9	3.4	0
NNW	1.2	5.8	5.8	2.0	1.5	0	0.7	2.6	3.9	3.9	2.5	0.5
	Calm 0						Calm 0					

TABLE 15.—*Average seasonal percentage frequency of free-air winds of different velocities at 500 and 1,000 meters, classified according to wind direction*—Continued

GROUP 2

SPRING

Wind direction	Velocity m. p. s., 500 m.						Velocity m. p. s., 1,000 m.					
	1-4	5-9	10-14	15-19	20-29	30+	1-4	5-9	10-14	15-19	20-29	30+
N	1.7	3.7	0.7	0.1	0	0	0.8	3.4	1.5	0	0	0
NNE	0.8	2.1	0.6	0.3	0	0	1.4	2.1	0.6	0.1	0	0
NE	0.6	1.7	0.6	0	0.1	0	1.2	1.3	0.4	0.2	0	0
ENE	1.3	1.1	0.3	0.2	0	0	0.5	1.4	0.8	0	0	0
E	0.5	1.5	0.6	0	0	0	0.4	0.6	0.7	0.2	0	0
ESE	0.9	0.6	0.6	0.3	0	0	0.6	0.6	0.3	0	0	0
SE	0.7	1.4	0.3	0.2	0	0	0.5	1.2	0.3	0.1	0	0
SSE	1.0	2.5	1.5	0.7	0.3	0.1	0.4	1.6	0.9	0.3	0.2	0.1
S	0.8	3.4	2.3	1.8	0.4	0	0.8	2.8	1.4	0.9	0.2	0.1
SSW	0.7	3.0	3.2	1.6	0.9	0	1.0	2.8	2.4	1.5	0.4	0
SW	1.2	2.6	2.8	1.5	0.5	0	0.5	3.4	3.9	1.7	1.0	0
WSW	1.2	3.3	2.3	1.3	0.6	0.1	1.1	4.7	3.8	1.7	1.0	0
W	1.1	4.2	2.5	0.6	0.1	0	1.4	5.1	3.9	1.8	0.3	0
WNW	1.3	3.0	2.9	1.2	0	0	0.5	4.4	3.0	1.3	0.2	0
NW	1.9	4.9	2.4	0.5	0	0	0.4	5.5	1.9	1.7	0.2	0
NNW	1.7	4.5	1.6	0.3	0	0	0.9	3.6	1.2	0.5	0.2	0
	Calm 0.1						Calm 0.2					

SUMMER

Wind direction	Velocity m. p. s., 500 m.						Velocity m. p. s., 1,000 m.					
	1-4	5-9	10-14	15-19	20-29	30+	1-4	5-9	10-14	15-19	20-29	30+
N	2.7	3.1	0.3	0	0	0	1.8	2.1	0.4	0	0	0
NNE	1.6	2.6	0.4	0	0	0	1.1	1.3	0.7	0.2	0	0
NE	1.1	1.5	0.3	0.1	0	0	1.3	1.3	0.2	0	0	0
ENE	1.8	0.7	0.2	0	0	0	1.2	1.3	0.2	0	0	0
E	0.9	0.5	0.5	0	0	0	1.0	1.1	0.1	0	0	0
ESE	2.1	1.0	0.3	0	0	0	1.6	1.0	0.2	0	0	0
SE	2.3	1.0	0.4	0	0	0	1.9	1.8	0.1	0	0	0
SSE	1.3	2.3	0.4	0	0	0	1.0	1.7	0.4	0	0	0
S	2.9	3.0	1.6	0.2	0	0	2.2	2.2	1.0	0	0	0
SSW	1.9	3.6	1.2	0.5	0.2	0	2.3	2.5	1.0	0.4	0	0
SW	2.5	3.7	2.3	0.4	0.1	0	2.0	3.7	2.2	0.4	0	0
WSW	2.5	3.2	3.0	0.6	0.2	0	1.6	3.8	4.0	0.9	0	0
W	3.0	5.9	1.1	0.7	0.1	0	1.4	7.1	3.3	1.0	0.2	0
WNW	2.2	4.7	1.4	0.3	0	0	2.6	5.8	2.9	0.9	0	0
NW	1.9	4.7	2.6	0.1	0	0	2.7	4.9	2.5	0.7	0	0
NNW	3.0	3.6	1.1	0	0	0	2.0	3.9	1.9	0.1	0.1	0
	Calm 0.6						Calm 0.8					

AUTUMN

Wind direction	Velocity m. p. s., 500 m.						Velocity m. p. s., 1,000 m.					
	1-4	5-9	10-14	15-19	20-29	30+	1-4	5-9	10-14	15-19	20-29	30+
N	1.9	1.8	0.7	0.1	0	0	1.0	1.6	1.1	0.1	0	0
NNE	0.6	1.6	0.5	0	0	0	0.7	1.4	0.1	0	0	0
NE	0.9	0.6	0.2	0	0	0	0.5	0.5	0	0	0	0
ENE	0.4	0.9	0	0	0	0	1.0	0.4	0	0	0	0
E	0.9	0.5	0.1	0	0	0	0.2	1.0	0	0	0	0
ESE	0.5	0.4	0.6	0	0	0	0.2	0.4	0	0	0	0
SE	0.9	0.7	0.1	0.2	0	0	0.5	0.4	0	0.1	0	0
SSE	1.2	2.0	0.5	0.1	0.1	0	0.6	0.7	0.6	0	0	0
S	1.2	4.5	2.9	0.4	0.4	0	1.0	2.2	1.4	0.5	0.1	0.1
SSW	1.4	3.6	3.0	1.0	0.3	0	0.7	3.3	3.3	1.1	0.2	0.1
SW	1.0	3.9	2.2	1.6	0	0	1.0	4.3	3.7	2.3	0.4	0
WSW	1.4	6.1	3.3	1.5	0.2	0	1.5	4.5	4.4	1.4	0.5	0
W	1.8	4.6	3.6	1.4	0.1	0	2.2	7.4	5.7	2.5	0.6	0
WNW	1.5	6.9	3.7	0.6	0.1	0	1.2	6.0	4.2	1.5	0.5	0
NW	1.3	4.8	2.8	0.6	0	0	0.9	4.9	4.1	1.5	0.5	0
NNW	1.6	3.7	1.4	0.4	0	0	1.2	2.1	1.4	0.2	0.1	0
	Calm 0.2						Calm 0.2					

WINTER

Wind direction	Velocity m. p. s., 500 m.						Velocity m. p. s., 1,000 m.					
	1-4	5-9	10-14	15-19	20-29	30+	1-4	5-9	10-14	15-19	20-29	30+
N	0.9	2.4	1.3	0	0.1	0	0.3	2.4	1.3	0.3	0	0
NNE	1.1	1.4	0.7	0	0	0	0.6	1.0	0.9	0	0	0
NE	0.6	1.4	0.4	0	0	0	0.4	0.6	0.3	0	0	0
ENE	0.3	0.6	0.3	0	0	0	0.1	0.9	0	0.1	0	0
E	0.7	0.9	0.3	0.2	0	0	0.1	0.4	0.3	0.1	0	0
ESE	0.9	0.3	0.3	0.1	0	0	0.3	0.6	0.1	0.1	0	0
SE	0.8	1.0	0.3	0	0	0	0.3	0.6	0.1	0	0	0
SSE	0.7	1.3	0.7	0	0.2	0	0.4	1.3	0.1	0	0	0
S	1.0	2.6	3.2	0.9	0.3	0	0.6	1.0	1.3	0.7	0	0
SSW	1.0	3.6	2.6	0.8	0.6	0	1.0	2.3	2.0	1.2	0	0
SW	2.0	2.4	2.4	1.0	1.0	0	0.7	4.0	2.6	1.8	0.6	0.1
WSW	1.0	4.0	2.8	1.2	0.8	0	1.3	5.0	4.0	2.6	1.6	0.1
W	2.4	6.3	3.6	1.2	0.6	0	1.0	5.0	5.6	3.2	0.9	0.1
WNW	1.6	5.5	3.3	1.3	0.3	0	0.9	4.8	6.2	2.2	0.3	0
NW	1.1	6.3	2.9	1.0	0	0	1.2	5.8	3.9	1.7	0.7	0.3
NNW	1.1	3.6	2.1	0.3	0	0	1.4	2.7	2.4	1.0	0.1	0.1
	Calm 0.1						Calm 0					

TABLE 15.—*Average seasonal percentage frequency of free-air winds of different velocities at 500 and 1,000 meters, classified according to wind direction*—Continued

GROUP 3

SPRING

Wind direction	Velocity m. p. s., 500 m.						Velocity m. p. s., 1,000 m.					
	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	1.5	2.1	2.2	0.2	0	0	0.9	2.8	2.0	0.5	0	0
NNE	1.4	1.8	0.6	0.2	0	0	1.6	1.8	1.0	0.3	0	0
NE	1.2	2.3	0.5	0.2	0	0	1.2	1.8	1.0	0.1	0	0
ENE	1.7	2.6	0.6	0	0	0	1.5	1.8	0.1	0.1	0	0
E	0.8	1.7	0.7	0.2	0	0	1.3	1.4	0.1	0.1	0	0
ESE	1.4	1.8	0.4	0.3	0	0	1.3	1.0	0.3	0.1	0.1	0
SE	1.0	1.3	0.2	0	0	0	1.0	0.8	0.2	0	0	0
SSE	1.3	1.6	0.8	0.1	0	0	1.8	1.5	0.2	0	0	0
S	1.7	3.5	1.3	0.9	0.2	0	1.0	2.6	1.2	0.2	0.2	0
SSW	1.7	4.5	3.6	1.5	0.6	0	2.0	3.0	2.8	1.0	1.0	0.1
SW	1.8	3.1	3.4	2.7	0.4	0	1.3	3.9	3.5	2.9	1.0	0
WSW	1.2	2.1	2.9	1.9	0.5	0	1.3	3.6	3.0	2.1	0.9	0
W	1.3	3.5	3.0	1.4	0.4	0	2.5	3.3	3.0	1.8	0.6	0
WNW	1.6	3.0	1.3	0.3	0	0	1.6	2.0	2.0	1.0	0	0
NW	1.4	1.7	1.0	0	0	0	1.6	3.1	1.6	0.7	0	0
NNW	1.4	3.9	1.9	0.4	0	0	1.3	2.2	2.4	0.3	0	0
	Calm 0.3						Calm 0.7					

SUMMER

Wind direction	Velocity m. p. s., 500 m.						Velocity m. p. s., 1,000 m.					
	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	3.5	2.7	0.2	0	0	0	2.0	2.0	0.7	0	0	0
NNE	3.1	1.9	0.2	0.2	0.2	0	2.4	3.0	0	0	0	0
NE	2.9	1.4	0.2	0	0	0	3.3	3.7	0.2	0	0	0
ENE	2.5	2.5	0.4	0.2	0	0	3.3	1.5	0.9	0	0	0
E	1.4	1.6	0.2	0.2	0	0	1.3	1.3	0.2	0.2	0	0
ESE	2.1	1.4	0	0	0	0	2.0	0.2	0	0	0	0
SE	2.5	1.0	0	0	0	0	2.0	0.9	0	0	0	0
SSE	2.7	1.2	0.4	0	0	0	2.0	1.3	0.2	0	0	0
S	1.9	2.3	0.2	0	0	0	0.7	2.4	0.9	0.2	0	0
SSW	1.9	2.5	1.4	0.2	0	0	2.0	2.4	0	0.2	0	0
SW	3.5	4.1	1.9	0	0	0	2.2	4.3	1.5	0.2	0	0
WSW	2.5	4.5	2.5	0.4	0	0	2.4	4.6	4.3	0.2	0	0
W	2.9	6.1	3.1	1.6	0	0	3.0	6.7	3.7	1.3	0	0
WNW	2.9	3.5	1.4	0	0	0	2.6	4.8	2.2	0.4	0	0
NW	1.6	3.3	0.4	0	0	0	1.5	2.6	0.7	0	0	0
NNW	2.7	3.1	0.4	0	0	0	2.4	4.6	0.4	0	0	0
	Calm 0.4						Calm 0					

AUTUMN

Wind direction	Velocity m. p. s., 500 m.						Velocity m. p. s., 1,000 m.					
	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	1.9	2.1	0.3	0	0	0	1.7	2.5	1.1	0	0	0
NNE	1.4	1.2	0.3	0	0	0	0.8	0.8	0.4	0.2	0	0
NE	0.5	1.9	0.3	0	0	0	1.3	2.3	0.2	0	0	0
ENE	1.2	0.5	0.3	0	0	0	0.9	1.3	0	0	0	0
E	1.4	1.7	0.5	0	0	0	1.5	1.1	0.2	0	0	0
ESE	1.4	1.0	0.5	0	0	0	0.9	0.2	0.8	0.2	0	0
SE	1.7	2.1	0.3	0	0	0	0.8	1.3	0	0	0	0
SSE	1.5	2.4	0.9	0	0	0	1.5	1.3	0.4	0	0	0
S	1.9	2.7	1.5	0.5	0.2	0	1.1	3.2	0.4	0	0	0
SSW	2.7	3.8	2.6	0.5	0.3	0	1.3	3.8	1.3	0.9	0.4	0
SW	1.7	5.0	3.1	1.0	0.2	0	3.0	4.3	4.5	0.9	0.2	0
WSW	1.9	5.7	3.8	1.4	0	0	2.1	4.9	3.6	2.1	0.2	0
W	2.2	5.0	3.9	0.9	0	0	1.9	5.9	5.5	1.5	0.7	0
WNW	2.1	2.9	2.2	0.7	0	0	1.0	2.3	3.8	1.1	0.6	0
NW	2.1	3.6	1.2	0.2	0	0	2.1	5.1	1.5	0.4	0.4	0
NNW	1.2	1.9	1.4	0.2	0	0	1.3	2.1	0.9	0	0	0
	Calm 0.5						Calm 0					

WINTER

Wind direction	Velocity m. p. s., 500 m.						Velocity m. p. s., 1,000 m.					
	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	0.9	1.9	0.8	0	0	0	0.6	1.6	1.1	0.5	0.3	0
NNE	1.5	1.8	0.4	0	0	0	0.3	1.4	0.8	0	0	0
NE	0.8	1.9	0.6	0	0	0	1.3	1.4	0.6	0.2	0	0
ENE	0.9	1.8	0.6	0	0	0	0.6	1.1	0	0	0	0
E	1.1	1.1	1.3	0.3	0.1	0	0.3	1.8	0.5	0.2	0.2	0
ESE	0.5	1.8	0.1	0	0	0	0.8	1.0	0.3	0	0	0
SE	1.0	2.1	0.1	0.4	0	0	0.5	1.1	0.2	0.2	0	0
SSE	0.8	1.6	0.6	0.5	0	0	0.6	1.6	1.0	0.2	0	0
S	0.8	2.3	0.8	0.5	0.3	0	0.6	1.1	0.6	0	0	0
SSW	0.9	2.0	1.9	1.1	0.8	0	0.5	1.0	1.4	0.8	0.5	0
SW	1.0	3.4	4.4	2.1	0.6	0	0.6	2.1	4.9	2.4	1.3	0
WSW	1.1	4.0	3.8	2.5	0.9	0	0.6	2.1	3.5	3.0	1.6	0
W	1.4	6.5	4.3	1.3	0.1	0.1	1.3	2.6	6.1	4.1	1.0	0.2
WNW	1.3	4.5	3.6	0.6	0.1	0	1.0	3.7	7.3	2.9	0.5	0
NW	1.3	3.6	2.5	0.5	0	0	0.8	4.9	3.8	1.4	1.1	0
NNW	1.1	3.5	0.5	0.3	0	0	1.1	2.7	1.6	0.5	0.2	0
	Calm 0.4						Calm 0.3					

TABLE 15.—*Average seasonal percentage frequency of free-air winds of different velocities at 500 and 1,000 meters, classified according to wind direction*—Continued

GROUP 4

SPRING

Wind direction	Velocity m. p. s., 500 m.						Velocity m. p. s., 1,000 m.					
	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	2.5	3.3	1.6	0.3	0.1	0	1.6	3.7	2.9	0.6	0.1	0
NNE	0.9	2.4	1.0	0.3	0	0	1.4	1.9	1.2	0.1	0	0
NE	1.1	1.7	0.8	0	0	0	0.8	1.6	0.9	0.1	0	0
ENE	1.1	1.6	0.6	0.1	0	0	0.6	1.0	0.2	0.3	0	0
E	0.8	1.1	0.5	0.1	0	0	0.6	0.5	0.2	0.1	0	0
ESE	1.3	0.9	0.3	0.1	0	0	0.5	0.6	0.5	0.1	0	0
SE	0.9	1.0	0.1	0.1	0	0	0.7	0.8	0.1	0	0.1	0
SSE	1.4	1.9	0.1	0.1	0	0	0.8	1.6	0.1	0	0	0
S	1.4	3.6	1.1	0.4	0.1	0	0.4	1.9	0.4	0.1	0.1	0
SSW	1.0	3.9	2.5	0.7	0.1	0.1	0.9	2.7	2.3	0.7	0.1	0
SW	1.4	4.2	2.1	1.0	0.5	0	1.3	4.6	3.2	1.1	0.4	0
WSW	1.1	4.3	2.3	0.8	0.3	0	1.0	3.9	2.9	1.1	0.3	0
W	1.6	4.1	2.0	0.9	0.2	0	1.0	5.4	3.1	1.4	0.3	0
WNW	1.1	4.3	2.7	0.9	0.2	0.1	1.8	3.9	4.3	1.6	0.4	0.1
NW	1.5	4.0	3.4	0.6	0.1	0.1	1.2	4.7	3.3	1.4	0.3	0.1
NNW	1.7	4.8	1.9	0.5	0	0	2.1	4.3	2.4	0.9	0.2	0
	Calm 0.3						Calm 0.1					

SUMMER

Wind direction	Velocity m. p. s., 500 m.						Velocity m. p. s., 1,000 m.					
	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	2.9	2.8	0.6	0.1	0	0	2.5	3.3	1.0	0.1	0	0
NNE	2.0	3.6	0.6	0	0	0	1.4	4.0	1.0	0	0	0
NE	2.4	3.1	0.8	0.2	0	0	1.8	1.7	0.8	0	0	0
ENE	2.3	2.0	0.8	0	0	0	1.8	2.8	0.7	0	0	0
E	1.6	1.5	0.6	0	0	0	1.4	1.1	0.1	0	0	0
ESE	1.0	1.2	0.3	0	0	0	0.7	0.8	0.2	0.2	0.1	0
SE	1.8	0.4	0	0	0	0	1.1	0.5	0	0	0	0
SSE	0.8	1.0	0.2	0	0	0	0.6	0.7	0.1	0	0	0
S	1.4	1.8	0.4	0	0	0	1.4	1.4	0.5	0	0	0
SSW	3.4	5.3	2.0	0.6	0	0	1.8	1.9	1.3	0.4	0.1	0
SW	2.5	4.8	1.7	0.3	0	0	2.7	4.5	2.7	0.5	0.1	0
WSW	2.5	6.5	1.9	0	0.1	0	2.8	5.9	2.6	0.1	0.1	0
W	2.5	3.5	1.0	0.3	0	0	2.2	7.0	2.0	0.2	0	0
WNW	1.9	2.6	1.3	0.2	0	0	2.6	4.1	2.2	0.5	0	0
NW	2.7	4.8	1.2	0.2	0	0	1.7	4.8	2.2	0.4	0	0
NNW	3.1	3.8	1.0	0	0	0	2.6	4.6	1.0	0.1	0.1	0
	Calm 0.3						Calm 0.4					

AUTUMN

Wind direction	Velocity m. p. s., 500 m.						Velocity m. p. s., 1,000 m.					
	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	2.0	2.8	1.3	0.1	0	0	1.8	4.5	1.0	0.1	0.1	0
NNE	1.2	2.3	0.6	0	0	0	0.8	3.0	1.0	0	0	0
NE	1.4	2.8	1.1	0	0	0	0.8	1.5	0.4	0	0	0
ENE	0.9	1.6	0.5	0	0	0	0.7	0.8	0.1	0	0	0
E	1.1	0.9	0.2	0.1	0	0	0.7	0.4	0.1	0	0	0
ESE	2.1	0.9	0.1	0	0	0	0.3	0.9	0.6	0	0	0
SE	1.5	1.2	0	0.1	0	0	0.8	1.0	0.1	0	0	0
SSE	1.2	1.2	0.2	0	0	0	0.3	0.7	0.2	0.2	0.1	0
S	0.9	1.6	0.9	0.1	0	0	1.1	1.8	0.4	0.2	0.2	0.1
SSW	1.4	2.6	1.5	1.1	0.1	0	0.7	1.6	2.2	0.4	0.2	0
SW	1.2	3.2	2.1	0.3	0.1	0	0.5	3.2	2.4	0.6	0.2	0
WSW	1.8	3.3	1.0	0.7	0.1	0	1.3	3.6	2.5	0.5	0.1	0
W	1.5	4.4	2.6	0.7	0.1	0	1.9	4.7	3.4	1.2	0.3	0
WNW	1.7	5.1	4.3	1.1	0.1	0	1.8	6.3	3.9	1.8	0.5	0
NW	2.0	5.9	6.0	0.9	0.1	0	1.8	8.6	4.2	1.7	0.2	0
NNW	1.8	4.8	3.1	0.2	0	0	1.3	5.3	3.1	1.3	0.2	0
	Calm 0.2						Calm 0.3					

WINTER

Wind direction	Velocity m. p. s., 500 m.						Velocity m. p. s., 1,000 m.					
	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	0.6	2.9	1.1	0.3	0	0	0.6	2.7	1.5	0.6	0.2	0
NNE	1.2	1.5	0.6	0	0	0	0.8	1.0	0.6	0.2	0	0
NE	0.8	2.0	0.7	0.6	0	0	0.3	0.8	0.5	0.3	0	0
ENE	0.9	0.8	0.5	0	0	0	0.1	0.8	0.6	0.3	0.1	0
E	0.4	0.5	0.2	0	0	0	0.3	0.6	0.1	0	0	0
ESE	0.9	0.8	0.3	0	0	0	0.2	0.1	0.1	0	0	0
SE	0.8	0.7	0.2	0	0	0	0.3	0.4	0	0	0	0
SSE	0.6	0.9	0.2	0	0	0	0.3	0.6	0.1	0	0	0
S	0.7	1.5	0.8	0.1	0	0	0.2	1.1	0.3	0	0	0
SSW	0.8	1.9	1.6	0.1	0	0	0.6	2.2	0.8	0.2	0.1	0
SW	0.6	2.9	2.3	1.0	0	0	0.6	1.7	2.1	1.0	0.3	0
WSW	0.9	2.5	2.7	1.3	0.1	0	0.6	3.5	3.6	1.6	0.5	0
W	1.8	4.6	3.4	1.8	0.3	0	0.5	4.6	5.8	3.0	0.8	0
WNW	1.6	5.6	7.6	2.9	0.4	0	1.0	5.2	7.4	3.9	1.8	0.1
NW	1.6	6.4	7.3	1.5	0.8	0	1.2	4.6	7.3	5.5	1.8	0.1
NNW	1.7	3.5	3.6	0.6	0.1	0	0.8	3.3	3.3	1.4	0.4	0
	Calm 0.1						Calm 0.1					

TABLE 15.—*Average seasonal percentage frequency of free-air winds of different velocities at 500 and 1,000 meters, classified according to wind direction*—Continued

GROUP 5

SPRING

Wind direction	Velocity m. p. s., 500 m.						Velocity m. p. s., 1,000 m.					
	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	1.4	3.0	2.3	0.3	0	0	0.9	3.7	1.9	0.4	0.2	0
NNE	1.1	2.8	1.2	0.5	0	0	0.9	2.8	0.6	0.2	0	0
NE	1.3	3.4	0.5	0.1	0	0	1.6	2.3	0.5	0	0.1	0
ENE	1.2	3.3	1.2	0.2	0	0	0.4	1.6	0.8	0	0	0
E	0.5	2.8	0.9	0.1	0	0	1.1	1.6	0.5	0	0.1	0
ESE	1.3	1.8	0.4	0	0	0	0.9	1.3	0.4	0	0	0
SE	1.0	1.8	0.4	0.1	0	0	1.1	0.9	0.4	0	0	0
SSE	0.7	1.6	0.8	0.1	0	0	0.6	1.2	0.2	0	0	0
S	1.8	1.9	1.4	0.8	0.1	0	0.8	1.9	0.7	0.5	0.1	0
SSW	1.5	3.0	2.5	1.0	0.8	0	0.9	3.2	1.8	0.6	0.5	0.2
SW	1.8	5.0	3.0	1.2	0.8	0	1.7	5.4	4.3	1.5	0.5	0.1
WSW	1.0	3.3	3.3	1.2	0.2	0	1.3	4.7	3.3	0.6	0.6	0
W	1.2	3.1	2.5	1.0	0.1	0.1	1.6	5.0	3.4	1.6	0.5	0
WNW	0.9	2.0	2.1	0.7	0	0	1.3	4.0	2.0	1.5	0	0
NW	1.0	3.0	1.2	0.1	0.1	0	1.1	3.5	1.6	0.5	0.3	0
NNW	1.5	3.0	2.0	0.5	0	0	1.2	3.3	2.3	0.6	0.2	0
	Calm 0.1						Calm 0.1					

SUMMER

Wind direction	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	1.6	2.6	1.2	0.1	0	0	1.5	3.0	1.2	0.1	0	0
NNE	1.3	4.0	0.8	0.1	0	0	2.2	4.0	0.7	0	0	0
NE	2.3	2.8	1.7	0	0	0	1.2	2.0	1.3	0.3	0	0
ENE	2.1	1.7	0.5	0.1	0	0	1.8	2.8	1.1	0	0	0
E	1.4	1.5	0.3	0.1	0	0	1.6	1.3	0.3	0	0	0
ESE	0.9	1.4	0.5	0	0	0	0.9	0.8	0.5	0	0	0
SE	1.6	1.5	0.2	0	0	0	1.2	1.8	0	0	0	0
SSE	0.9	1.7	0.2	0	0	0	0.8	0.8	0.1	0	0	0
S	2.1	3.3	0.9	0	0	0	1.3	1.5	0.5	0.3	0	0
SSW	2.3	5.2	2.3	0.5	0	0	1.8	3.3	1.3	0.4	0	0
SW	2.1	5.8	2.4	0.5	0.2	0	2.8	6.9	2.4	0.4	0.3	0
WSW	2.3	5.6	3.0	0.5	0.1	0	2.8	7.7	2.4	0.7	0.1	0
W	3.3	4.3	2.5	0.2	0.1	0	2.5	5.8	2.4	0.5	0	0
WNW	1.8	3.2	0.9	0.1	0	0	2.0	4.4	0.7	0	0	0
NW	2.5	1.5	0.2	0	0	0	2.6	3.4	0.7	0.3	0	0
NNW	2.8	1.5	0.7	0.1	0	0	1.5	1.6	0.9	0.5	0	0
	Calm 0.1						Calm 0					

AUTUMN

Wind direction	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	3.0	3.4	3.4	0.2	0	0	2.4	3.7	1.7	0.2	0	0
NNE	2.5	4.1	2.8	0.3	0.1	0	1.5	3.3	1.9	0.2	0.2	0
NE	1.9	4.9	3.5	0.1	0	0	1.7	3.7	1.5	0.6	0	0
ENE	1.8	2.8	1.3	0.2	0	0	1.0	2.0	1.1	0.1	0	0
E	2.3	1.5	0.6	0	0	0	0.6	1.2	0.2	0	0	0
ESE	0.8	0.5	0	0	0	0	0.6	0.6	0.1	0	0	0
SE	1.2	1.5	0.4	0	0	0	1.1	0.8	0	0	0	0
SSE	0.9	1.4	0.4	0	0	0	1.0	0.8	0.4	0	0	0
S	1.2	1.4	0.3	0.2	0.1	0	1.2	1.3	0.4	0.2	0	0
SSW	1.4	2.5	0.6	0.6	0.1	0	0.6	2.1	1.0	0.5	0.1	0
SW	1.9	3.0	1.5	0.5	0.1	0	1.2	5.2	1.8	0.4	0.7	0
WSW	1.6	3.5	3.0	0.9	0.1	0	2.4	4.2	1.3	0.8	0.3	0
W	1.4	3.0	2.2	1.4	0.2	0	2.7	5.7	3.0	1.3	0.4	0
WNW	1.5	2.9	1.8	0.5	0	0	1.9	4.5	1.7	0.6	0.1	0
NW	1.4	2.8	1.1	0.1	0.1	0	3.0	4.2	1.5	0.2	0	0
NNW	1.5	3.4	1.8	0.4	0	0	1.9	4.4	1.8	0.7	0	0
	Calm 0.2						Calm 0.5					

WINTER

Wind direction	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	1.3	3.1	2.2	0.4	0	0	1.0	2.9	1.2	0.4	0.3	0
NNE	1.2	3.2	1.3	0.1	0	0	1.0	1.6	0.3	0	0	0
NE	1.2	2.9	1.3	0.1	0.1	0	0.4	0.7	0.7	0.3	0	0
ENE	0.7	1.7	1.3	0.1	0	0	0.4	0.6	0.1	0.1	0	0
E	0.7	1.3	0.7	0.1	0	0	0.4	0.6	0.2	0.1	0	0
ESE	0.9	1.0	0.2	0	0	0	0.4	0.1	0.3	0.1	0	0
SE	0.5	0.7	0	0.1	0	0	0.6	0.3	0.1	0.1	0	0
SSE	0.7	1.0	0.2	0	0.1	0	0.3	1.0	0.3	0	0	0
S	0.8	1.9	0.9	0.4	0.1	0	0.7	1.0	0.6	0.2	0	0
SSW	1.3	2.1	1.3	0.4	0.1	0	0.7	2.1	1.4	0.6	0.3	0.1
SW	1.3	3.1	2.5	1.3	1.1	0	0.9	2.5	2.5	1.0	1.2	0
WSW	1.4	3.7	3.1	1.8	0.9	0	0.9	4.0	3.8	2.8	1.3	0.3
W	1.3	4.2	4.2	2.3	0.6	0	1.2	5.7	6.9	2.5	2.1	0
WNW	1.5	4.1	3.6	1.2	0.1	0	1.0	4.9	5.1	2.4	0.6	0
NW	1.3	4.1	2.6	1.0	0	0	0.8	6.0	5.2	1.6	0.3	0
NNW	1.3	3.7	1.7	1.2	0.1	0	1.0	3.8	2.3	0.7	0	0
	Calm 0						Calm 0.1					

TABLE 15.—*Average seasonal percentage frequency of free-air winds of different velocities at 500 and 1,000 meters, classified according to wind direction*—Continued

GROUP 6

SPRING

Wind direction	Velocity m. p. s., 500 m.						Velocity m. p. s., 1,000 m.					
	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	2.2	2.7	1.3	0	0	0	1.6	5.2	1.6	0	0	0
NNE	1.6	2.2	0.7	0	0	0	1.4	1.0	1.4	0	0	0
NE	0.5	2.2	0.7	0	0	0	0.8	1.2	0.4	0.4	0	0
ENE	1.8	1.8	1.1	0.2	0	0	1.4	1.8	0.4	0	0	0
E	1.3	2.4	1.3	0	0	0	0.6	1.2	0.4	0	0	0
ESE	1.4	2.5	0.7	0	0	0	1.2	2.0	0.4	0	0	0
SE	2.4	2.0	0.9	0	0	0	1.2	2.2	0.2	0.4	0	0
SSE	1.8	2.5	1.1	0.9	0.2	0	0.8	3.2	1.0	0.4	0.2	0
S	1.8	5.8	2.2	0.9	0.7	0	1.8	3.8	3.4	0.8	0.2	0
SSW	0.9	3.1	2.5	0.4	0.4	0	1.6	5.2	2.0	0.6	0.6	0
SW	2.0	2.5	0.7	0.4	0	0	2.2	2.8	1.4	0.6	0.2	0
WSW	1.8	1.6	1.1	0	0	0	0.6	3.6	1.0	0.6	0	0
W	2.2	4.0	0.4	0	0	0	2.2	2.6	1.0	0.2	0	0
WNW	2.5	2.7	0.5	0.5	0	0	1.6	4.4	1.6	0.2	0	0
NW	3.1	3.6	1.4	0.7	0	0	2.8	4.0	3.0	0.8	0	0
NNW	2.5	4.3	2.0	0	0	0	1.8	4.2	2.2	0.2	0	0
	Calm 0.4						Calm 0.2					

SUMMER

Wind direction	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	1.5	0.3	0	0	0	0	2.7	1.1	0	0	0	0
NNE	1.5	0.5	0	0	0	0	1.6	0.5	0	0	0	0
NE	1.0	1.3	0.3	0	0	0	0.5	0.8	0.8	0	0	0
ENE	3.4	2.6	1.3	0	0	0	3.3	3.3	0.5	0.3	0	0
E	1.8	2.6	1.5	0	0	0	1.6	1.9	1.6	0.3	0	0
ESE	1.8	2.6	0.8	0	0	0	1.6	3.5	0.3	0.3	0	0
SE	2.6	0.3	0.3	0	0	0	1.9	1.1	0	0	0	0
SSE	1.3	1.8	0.3	0	0	0	2.2	0.8	0	0	0	0
S	2.6	1.3	0.8	0.3	0	0	0.8	1.1	0.5	0.3	0	0
SSW	4.6	4.1	1.0	0	0	0	2.4	4.9	1.1	0	0	0
SW	3.4	4.1	0	0	0	0	4.6	5.1	0.8	0.3	0	0
WSW	7.5	4.4	0.5	0	0	0	7.0	6.2	1.1	0	0	0
W	6.4	3.9	1.0	0	0	0	4.6	5.1	1.5	0	0	0
WNW	6.7	4.1	1.8	0	0	0	3.8	4.3	0.8	0.3	0	0
NW	3.6	2.3	0	0	0	0	3.0	2.2	0.3	0	0	0
NNW	1.8	2.1	0	0	0	0	3.0	1.1	0.3	0	0	0
	Calm 0.3						Calm 0.5					

AUTUMN

Wind direction	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	2.0	2.8	0.7	0	0	0	1.8	3.7	1.4	0	0	0
NNE	2.0	4.3	0.2	0	0	0	3.7	1.8	0.5	0	0	0
NE	3.9	2.4	0.9	0.2	0	0	3.9	1.8	0.7	0	0	0
ENE	3.3	4.1	0.4	0.2	0	0	3.0	3.7	0.2	0	0	0
E	4.8	5.9	1.2	0.2	0	0	2.5	4.6	0.5	0	0	0
ESE	2.4	3.9	1.3	0.2	0	0	3.2	2.8	1.6	0	0	0
SE	2.0	1.3	0.2	0.2	0	0	3.2	2.3	0.2	0.2	0	0
SSE	2.2	2.6	0.4	0.7	0	0	2.1	1.8	1.2	0.7	0	0
S	1.3	1.7	0.9	0.2	0	0	2.5	1.2	1.2	0	0.2	0
SSW	1.3	1.1	0.2	0.4	0	0	1.6	0.9	0.9	0.5	0.2	0
SW	1.5	0.9	0	0.2	0	0	0.7	3.2	0.7	0	0	0
WSW	2.2	2.0	0.2	0	0	0	1.8	1.4	0.5	0.2	0	0
W	2.6	2.0	0.9	0.2	0	0	1.8	2.8	0.9	0.3	0	0
WNW	3.7	2.0	0.9	0.4	0	0	2.5	2.8	1.2	0.9	0	0
NW	3.0	2.6	0.7	0.2	0	0	1.8	4.4	2.1	0.7	0.2	0
NNW	3.9	2.4	1.5	0.4	0	0	2.3	3.0	0.9	0	0	0
	Calm 0.8						Calm 0.8					

WINTER

Wind direction	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	1.6	3.8	1.1	0.3	0	0	2.1	3.2	1.8	0.7	0	0
NNE	1.1	2.1	1.7	0	0	0	0.5	1.6	1.2	0.2	0.2	0
NE	1.1	1.1	0.5	0.3	0	0	0.4	0.7	0.9	0.2	0	0
ENE	1.3	1.4	0.6	0.2	0	0	0.5	0.7	0.5	0	0	0
E	0.6	1.4	0.8	0.5	0	0	0.7	0.5	0.7	0	0	0
ESE	0.8	1.1	0.9	0	0	0	0.4	0.9	0.5	0	0	0
SE	0.8	1.7	1.6	0.3	0	0	0.4	0.2	0.5	0.4	0	0
SSE	1.4	1.4	0.8	0.2	0	0	0.9	1.6	1.2	0.5	0.2	0
S	1.6	2.8	1.4	0.5	0.3	0	1.4	2.1	1.6	0.6	0	0
SSW	2.2	3.5	1.3	0.5	0	0	1.2	2.3	0.5	1.1	0.2	0
SW	2.7	3.2	1.6	0.2	0.2	0	1.8	3.4	3.2	0.9	0.2	0
WSW	1.5	4.4	1.1	0.8	0.2	0	2.1	3.2	2.5	0.7	0.4	0
W	2.7	3.0	1.7	0	0.2	0	2.1	5.5	3.6	0.7	0.4	0.2
WNW	3.0	4.0	3.0	0.3	0.2	0	1.6	4.6	4.3	1.6	0.2	0
NW	3.0	5.9	1.9	0.3	0	0	1.4	6.7	4.3	0.6	0.2	0
NNW	2.1	4.0	1.7	0.3	0	0	1.6	3.7	2.3	0	0	0
	Calm 0.2						Calm 0					

TABLE 15.—*Average seasonal percentage frequency of free-air winds of different velocities at 500 and 1,000 meters, classified according to wind direction*—Continued

GROUP 7

SPRING

Wind direction	Velocity m. p. s., 500 m.						Velocity m. p. s., 1,000 m.					
	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	2.3	3.7	2.3	0	0	0	1.4	4.1	0.8	0.5	0	0
NNE	1.4	2.1	1.2	0	0	0	2.4	0.8	0.5	0.3	0	0
NE	1.2	1.6	0.5	0.5	0	0	1.6	2.2	0	0	0	0
ENE	1.6	2.1	1.2	0	0	0	2.4	3.3	0.8	0	0	0
E	1.4	6.5	2.8	0	0	0	2.4	6.8	0.3	0	0	0
ESE	0.9	6.1	3.7	0.2	0	0	2.4	6.2	1.9	0.3	0	0
SE	2.1	4.4	3.3	0.9	0	0	1.6	5.4	2.2	0	0	0
SSE	2.1	4.0	3.3	0.5	0	0	2.4	2.7	1.9	0.5	0	0
S	1.9	2.3	2.1	0.7	0	0	1.1	2.7	2.4	0	0	0
SSW	1.2	2.8	0.7	0	0	0	0.8	2.2	1.6	0.3	0	0
SW	2.3	1.4	0.7	0	0	0	1.1	2.2	1.4	0	0	0
WSW	1.4	1.6	0.5	0.2	0	0	0.8	1.1	1.1	0	0	0
W	0.9	1.6	0.2	0.2	0	0	0.9	3.5	0.3	0.3	0	0
WNW	0.5	1.4	0.2	0	0	0	1.1	3.0	0.5	0	0	0
NW	2.8	2.6	0.5	0	0	0	3.0	3.5	0.5	0	0	0
NNW	1.9	2.6	0.9	0	0	0	1.9	3.0	1.6	0	0	0
	Calm 0						Calm 0					

SUMMER

N	0.6	1.1	0.3	0.3	0	0	2.0	2.3	0.3	0	0	0
NNE	0.8	1.4	0.3	0	0	0	1.3	1.0	0.7	0	0	0
NE	1.1	0.8	0.3	0	0	0	2.0	0.3	0	0	0	0
ENE	2.0	2.0	0.8	0	0	0	2.9	2.9	0.3	0	0	0
E	3.1	7.0	0.6	0	0	0	3.9	7.2	1.6	0	0	0
ESE	5.6	10.7	2.5	0	0	0	2.0	7.5	2.0	0.3	0	0
SE	3.4	5.7	1.1	0	0	0	3.6	4.6	1.6	0	0	0
SSE	2.8	3.4	0	0	0	0	2.9	2.9	0	0	0	0
S	3.1	4.2	0.3	0	0	0	2.6	2.0	0.3	0	0	0
SSW	2.3	4.2	0.6	0	0	0	1.6	3.9	0.7	0.3	0	0
SW	3.7	4.8	0.3	0	0	0	3.6	4.6	0.3	0	0	0
WSW	2.3	3.9	0.7	0	0	0	1.6	4.6	1.0	0	0	0
W	2.0	2.8	0.6	0	0	0	3.4	4.2	1.0	0	0	0
WNW	1.1	1.7	0.3	0	0	0	2.0	1.6	0	0	0	0
NW	1.1	0.6	0	0	0	0	1.0	1.0	0	0	0	0
NNW	1.1	0.3	0.3	0	0	0	2.3	0	0.3	0	0	0
	Calm 0						Calm 0					

AUTUMN

N	2.6	3.3	1.3	0	0	0	1.5	4.6	0.4	0	0	0
NNE	1.0	2.6	1.7	0	0	0	1.1	4.2	0.4	0	0	0
NE	0.7	3.3	2.3	0	0	0	1.5	4.2	0.8	0	0	0
ENE	2.3	6.6	5.6	1.0	0	0	3.1	8.0	1.1	0.8	0	0
E	3.0	5.6	6.3	0.3	0	0	5.0	5.3	4.6	0	0	0
ESE	3.3	6.0	2.6	0	0	0	2.7	8.0	0.8	0	0	0
SE	3.0	5.3	2.0	0	0	0	2.3	4.6	0.4	0	0	0
SSE	0	1.7	0.3	0	0	0	2.7	2.3	0	0	0	0
S	1.7	1.0	0.7	0	0	0	1.1	1.9	0.5	0	0	0
SSW	2.6	0.3	0	0	0	0	0.4	0.4	0.4	0	0	0
SW	1.0	1.3	0.3	0	0	0	3.1	1.5	0	0	0	0
WSW	0.7	2.0	0.7	0	0	0	0.4	1.9	0	0	0	0
W	1.7	1.0	0	0	0	0	1.9	0.8	0.4	0	0	0
WNW	2.0	1.0	0	0	0	0	2.7	2.3	0.4	0	0	0
NW	1.7	1.3	1.0	0	0	0	2.3	2.3	0.5	0.4	0	0
NNW	2.3	1.7	0.3	0	0	0	1.1	1.5	1.1	0	0	0
	Calm 0						Calm 0.3					

WINTER

N	1.2	2.8	1.5	0.3	0	0	0.7	1.4	0.7	0.7	0	0
NNE	1.2	3.0	0	0.3	0	0	1.0	0.3	0.7	0	0	0
NE	0.9	1.5	0.6	0	0	0	0.7	1.7	0	0	0	0
ENE	1.2	2.8	2.5	0.6	0.3	0	1.7	0.7	0.7	1.0	0	0
E	1.9	5.3	3.4	0	0	0	2.4	4.2	2.1	0.3	0	0
ESE	1.2	2.5	3.0	0	0	0	1.7	3.8	0.7	0	0	0
SE	1.2	4.7	2.5	0	0	0	3.8	4.5	2.1	0	0	0
SSE	0.6	2.8	2.2	0.6	0	0	1.4	2.4	1.0	0.7	0	0
S	0.9	2.5	0.6	0.3	0	0	1.7	4.2	1.4	0.3	0	0
SSW	0.6	3.4	2.5	0	0.3	0	1.0	2.5	1.4	0	0	0
SW	1.2	2.2	0.9	0.6	0	0	1.4	4.5	1.0	1.0	0	0
WSW	1.3	2.2	0.3	1.9	0	0	1.4	4.9	1.0	0	0.3	0
W	2.2	1.3	1.2	0.3	0	0	1.7	1.7	2.4	0.3	0	0
WNW	1.2	1.9	2.8	0	0.3	0	2.8	2.4	2.4	1.4	0.7	0
NW	1.9	3.0	2.2	0.9	0	0	1.0	2.8	2.1	1.4	0	0
NNW	0.6	4.1	1.5	0.3	0	0	0.3	4.2	1.0	0.3	0	0
	Calm 0						Calm 0					

TABLE 15.—*Average seasonal percentage frequency of free-air winds of different velocities at 500 and 1,000 meters, classified according to wind direction*—Continued

GROUP 8

SPRING

Wind direction	Velocity m. p. s., 500 m.						Velocity m. p. s., 1,000 m.					
	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	1.7	1.7	1.6	0.4	0.4	0	0.9	2.1	1.5	1.3	0.1	0
NNE	1.3	2.2	1.4	0.5	0.1	0	0.8	1.3	1.2	0.3	0	0
NE	0.8	2.1	1.2	0.5	0.1	0	1.3	1.6	0.6	0.1	0	0
ENE	1.2	1.2	0.8	0.2	0	0	0.9	0.6	0.1	0	0	0
E	1.5	0.8	0.4	0	0	0	1.2	1.4	0.2	0.1	0	0
ESE	0.9	0.9	0.2	0.1	0.1	0	0.9	1.0	0.3	0.1	0	0
SE	1.3	1.5	0.9	0.2	0	0	1.5	1.2	0.6	0.1	0	0
SSE	0.9	2.6	2.1	0.8	0	0	0.8	1.8	0.7	0.3	0	0
S	1.7	5.1	5.7	3.4	1.7	0	1.2	3.5	4.6	1.0	0.6	0
SSW	1.3	5.2	6.4	3.6	2.5	0	1.4	5.9	6.8	2.9	1.5	0
SW	1.3	1.8	2.9	1.8	0.7	0	0.6	6.8	4.0	3.2	0.9	0.1
WSW	1.1	1.2	1.2	0.9	0.1	0	0.8	2.9	1.6	1.7	0.7	0
W	1.0	1.1	0.5	0.5	0.1	0	1.4	1.7	1.2	0.5	0.5	0
WNW	1.2	0.6	0.4	0.1	0	0	1.0	1.6	0.7	0.1	0.1	0
NW	0.9	1.3	1.1	0.4	0	0	1.2	2.1	0.8	0.6	0	0
NNW	1.7	1.9	2.0	0.8	0.1	0	1.4	2.3	2.0	0.7	0.2	0
	Calm 0.1						Calm 0.3					

SUMMER

N	1.3	1.6	0.9	0	0	0	1.7	1.5	0.5	0	0	0
NNE	0.9	2.3	0.4	0.4	0	0	0.8	1.5	0	0	0	0
NE	2.3	2.0	0.6	0.1	0	0	1.7	2.7	0.5	0	0	0
ENE	1.7	1.3	0.3	0	0	0	0.6	1.1	0	0	0	0
E	1.6	2.1	0	0.1	0	0	2.1	1.2	0.6	0.2	0	0
ESE	1.9	1.3	0.3	0	0	0	2.0	1.5	0.2	0	0	0
SE	2.9	2.1	0.1	0.1	0.1	0	1.8	2.0	0.2	0	0.2	0
SSE	3.1	3.4	1.3	0.1	0	0	2.4	3.0	0.5	0.2	0	0
S	3.6	7.7	3.1	1.1	0.3	0	3.6	8.2	2.7	0.5	0	0
SSW	2.3	7.1	5.3	2.9	0.4	0	2.9	9.8	4.2	1.1	0	0.2
SW	2.0	3.4	5.6	2.0	0.6	0	3.2	6.5	4.2	1.7	0.2	0
WSW	1.0	1.6	1.9	1.9	0.3	0	1.5	2.4	2.4	0.8	0.3	0
W	1.3	1.0	0.6	0.1	0	0	1.1	0.9	0.8	0.2	0	0
WNW	0.7	0.6	0.6	0	0	0	1.5	1.7	0.5	0.2	0	0
NW	1.4	0.3	0	0	0.1	0	1.4	0.8	0.3	0.2	0.2	0
NNW	1.1	1.1	0.3	0.1	0	0	1.8	0.9	0.2	0	0	0
	Calm 0						Calm 0.2					

AUTUMN

N	1.4	1.8	1.4	1.0	0.3	0	0.8	2.0	2.0	0.6	0	0
NNE	1.0	3.1	2.0	0.8	0.3	0	0.6	2.2	1.9	0.8	0	0
NE	1.5	2.5	1.5	0.6	0	0	1.1	3.3	1.9	0	0	0
ENE	0.6	1.8	0.4	0.4	0	0	0.6	0.9	0.2	0	0	0
E	1.1	0.4	0.1	0	0	0	1.7	0.9	0	0	0	0
ESE	0.4	0.3	0	0	0	0	0.9	0.9	0	0	0	0
SE	0.8	2.1	0.3	0	0	0	0.9	0.8	0.2	0	0	0
SSE	1.7	2.5	2.0	0.4	0	0	0.8	2.0	0.6	0	0	0
S	2.5	5.8	7.0	1.8	0.7	0	1.2	4.0	3.9	1.1	0.5	0
SSW	1.7	5.9	5.1	3.4	1.8	0	1.7	7.9	6.2	3.0	0.9	0
SW	0.4	2.8	1.8	2.5	2.0	0	1.7	3.9	4.2	3.1	0.5	0
WSW	1.1	1.3	1.3	0.3	0.1	0	0.9	3.1	2.6	1.9	0	0
W	1.8	1.7	0.7	0.1	0	0	1.4	2.6	1.1	0.2	0	0
WNW	0.6	1.0	0.6	0	0	0	0.9	1.2	0.9	0.3	0	0
NW	1.4	1.8	0.8	0.7	0	0	0.5	1.2	1.2	0.9	0.2	0
NNW	1.5	1.3	0.8	1.0	0	0	1.9	1.4	1.7	1.1	0.3	0
	Calm 0.4						Calm 0.1					

WINTER

N	1.3	3.7	3.0	0.9	0.4	0	1.2	1.9	2.5	1.0	0.1	0
NNE	0.9	2.3	2.1	0.9	0.6	0	1.2	1.5	1.6	0.9	0.5	0
NE	1.2	1.3	0.9	0.1	0	0	0.4	0.7	0.7	0.1	0	0
ENE	1.0	1.3	0.1	0.1	0	0	0.6	0.7	0.1	0	0	0
E	0.2	0.8	0.1	0	0	0	0.5	0.1	0.2	0.1	0	0
ESE	0.3	0.6	0.1	0.1	0	0	0.4	0.4	0.2	0	0	0
SE	0.6	0.7	0.6	0.1	0	0	0.5	0.1	0.1	0.2	0	0
SSE	1.0	1.8	0.8	0.1	0	0	0.7	0.6	0.7	0	0	0
S	1.3	3.2	1.2	0.4	0.3	0	1.2	1.7	1.0	0.4	0	0
SSW	1.4	4.8	6.4	1.2	2.0	0	0.9	2.3	2.6	1.7	0.9	0
SW	1.3	4.4	3.7	2.1	1.3	0	1.0	3.7	7.0	5.4	2.1	0
WSW	1.1	3.6	2.8	0.8	0.2	0	1.4	3.1	4.9	2.2	0.8	0
W	1.4	2.1	0.9	0.4	0.3	0	0.4	4.3	2.0	0.7	0.6	0
WNW	1.1	2.0	1.9	0.1	0	0	0.4	3.0	2.3	0.9	0	0
NW	1.8	3.9	1.5	0.7	0.1	0	0.9	3.3	3.6	1.2	0.2	0
NNW	1.0	3.3	2.1	1.2	0.7	0	0.5	4.4	3.1	2.7	0.7	0
	Calm 0						Calm 0					

TABLE 15.—*Average seasonal percentage frequency of free-air winds of different velocities at 500 and 1,000 meters, classified according to wind direction*—Continued

GROUP 9

SPRING

Wind direction	Velocity m. p. s., 500 m.						Velocity m. p. s., 1,000 m.					
	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	1.6	3.0	1.4	0.3	0.1	0	1.3	2.3	1.1	0.4	0	0
NNE	1.3	1.5	0.9	0.3	0.1	0	2.1	0.9	1.2	0.1	0.1	0
NE	2.3	0.9	0.9	0	0	0	1.4	2.1	0.2	0	0	0
ENE	2.0	1.5	0.2	0.2	0	0	1.8	1.1	0	0	0	0
E	1.9	1.7	0.6	0	0	0	1.9	0.8	0.3	0	0	0
ESE	2.0	2.8	0.6	0	0	0	2.1	1.8	0.4	0	0	0
SE	3.8	4.2	2.5	0.2	0	0	2.4	5.0	1.0	0.2	0	0
SSE	3.5	7.6	3.1	0.6	0.1	0	2.5	6.1	2.2	0.6	0.1	0
S	3.6	7.2	5.0	1.7	0.5	0	3.4	6.7	3.4	1.7	0.4	0
SSW	1.5	2.7	2.5	1.2	0.6	0	1.2	4.7	2.4	1.2	0.4	0
SW	1.3	1.9	0.4	0.3	0.1	0	1.2	3.1	1.0	0.8	0.1	0
WSW	0.7	1.6	0.4	0	0.1	0	1.5	1.3	1.2	0.2	0.1	0
W	1.1	1.2	0.3	0	0.1	0	1.1	1.9	1.2	0	0	0
WNW	0.6	1.1	0.3	0.2	0	0	1.1	1.6	0.9	0.3	0	0
NW	0.6	1.3	0.6	0.2	0	0	1.0	1.9	1.9	0.2	0.1	0
NNW	0.8	2.0	1.2	0.9	0.3	0	1.2	3.0	2.0	0.9	0	0
	Calm 0.2						Calm 0.1					

SUMMER

Wind direction	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	1.0	0.3	0.3	0	0	0	1.5	0.3	0.2	0.2	0	0
NNE	0.9	0.9	0	0	0	0	1.5	0.5	0.2	0	0	0
NE	1.4	1.2	0	0	0	0	1.4	0.9	0	0	0	0
ENE	3.0	1.4	0	0	0	0	2.1	1.2	0.1	0	0	0
E	2.0	2.2	0.1	0.1	0	0	2.9	1.5	0	0	0	0
ESE	4.7	2.5	0	0	0	0	4.4	2.6	0.2	0	0	3
SE	6.6	4.5	0.1	0.1	0	0	5.6	3.2	0.2	0	0	0
SSE	6.3	6.4	0.7	0	0	0	5.7	7.2	0 9	0	0	0
S	6.4	7.9	2.1	0	0	0	9.6	6.6	1.8	0.2	0	0
SSW	6.0	6.8	2.2	0.5	0	0	4.7	7.4	1.5	0.5	0	0
SW	2.2	3.9	1.6	0.1	0	0	4.1	5.7	1.2	0	0.2	0
WSW	2.6	2.6	0.5	0	0	0	2.4	1.5	0	0	0	0
W	1.7	0.5	0	0	0	0	2.0	0.5	0.1	0	0	0
WNW	1.0	0.7	0	0	0	0	1.2	0.3	0	0	0	0
NW	1.2	0.4	0.3	0	0	0	1.2	1.1	0	0	0	0
NNW	0.9	0.4	0.5	0	0	0	1.1	0.3	0.1	0	0	0
	Calm 0.3						Calm 0.2					

AUTUMN

Wind direction	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	1.5	3.1	1.1	0.7	0	0	1.3	2.9	2.0	0.4	0	0
NNE	1.9	3.2	2.1	0.4	0	0	2.0	3.9	1.0	0.4	0.1	0
NE	2.3	3.7	1.2	0.5	0	0	2.7	3.5	1.0	0.1	0	0
ENE	2.3	2.7	0.6	0.2	0	0	2.1	2.5	0.3	0.1	0	0
E	3.1	1.9	0.4	0	0	0	2.4	1.8	0	0.1	0	0
ESE	1.7	3.0	0.2	0.1	0	0	2.4	1.4	0.1	0	0	0
SE	2.6	4.2	1.7	0.1	0	0	1.5	2.1	0.6	0	0	0
SSE	3.5	6.3	3.2	0.5	0 1	0	3.5	6.0	2.4	0.1	0	0
S	3.3	6.0	3.7	0.7	0.1	0	3.4	5.4	3.8	1.1	0	0
SSW	1.5	4.1	2.2	1.1	0	0	1.4	4.9	4.3	0.6	0.1	0
SW	1.5	1.4	0.6	0	0	0	1.3	1.1	1.0	0.3	0	0
WSW	0.5	0.6	0.1	0	0	0	1.3	1.3	0.6	0.3	0	0
W	0.6	0.8	0.2	0.2	0.1	0	1.5	1.7	0.6	0.3	0.3	0
WNW	1.0	0.9	0.5	0.3	0.2	0	0.7	0.8	0.4	0.4	0	0
NW	1.0	0.7	0.7	0.5	0.1	0	1.7	2.0	0.1	1.1	0.3	0
NNW	1.4	2.2	0.5	0.5	0	0	1.4	1.8	1.1	0.8	0.1	0
	Calm 0.1						Calm 0					

WINTER

Wind direction	1–4	5–9	10–14	15–19	20–29	30+	1–4	5–9	10–14	15–19	20–29	30+
N	1.1	4.3	2.1	0.5	0	0	1.9	4.6	2.2	1.1	0	0
NNE	2.1	3.1	1.7	0.2	0.2	0	1.9	1.9	0.8	0.3	0	0
NE	1.6	2.4	0.6	0	0	0	1.1	1.6	0.2	0.1	0	0
ENE	2.0	1.2	0.5	0.1	0	0	1.4	0.6	0.5	0	0	0
E	1.1	1.5	0.3	0	0	0	0.6	0.7	0.1	0	0	0
ESE	1.2	1.2	0.2	0.1	0	0	0.6	0.6	0.1	0.1	0	0
SE	1.5	1.5	1.4	0.1	0	0	0.8	1.3	0.6	0	0	0
SSE	1.8	2.9	1.1	0.4	0	0	2.1	1.8	0.3	0.1	0	0
S	2.0	5.4	2.8	1.6	0.1	0	0.9	3.8	1.9	1.3	0	0
SSW	2.0	4.2	3.5	1.3	0.5	0	1.0	5.8	3.7	1.7	0.7	0
SW	1.3	3.1	1.6	0.7	0.1	0	1.7	5.1	3.0	0.9	0	0
WSW	1.5	2.4	0.8	0.2	0	0	1.1	3.2	1.5	0.3	0	0
W	1.5	2.0	0.8	0.1	0.1	0	1.6	2.2	1.3	0.6	0.1	0
WNW	1.7	2.1	1.1	0.5	0.2	0	0.7	2.7	3.7	0.6	0.7	0
NW	1.3	3.1	1.6	0.4	0.1	0	1.5	3.0	4.3	0.7	0.3	0
NNW	1.7	3.9	2.2	0.4	0	0	1.3	3.4	2.4	1.1	0.2	0
	Calm 0.1						Calm 0					

TABLE 16.—*Maximum free-air wind velocities, m. p. s. at various levels*

GROUP 1

	Surface		Altitude, meters									
			500		1,000		2,000		4,000		6.000	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Spring	nw.	27	sw.	28	sw.	33	ssw.	32	nw.	31	wnw.	33
Summer	nw.	19	ssw.	24	wsw.	29	wnw.	27	wnw.	26	nw.	29
Autumn	ssw.	23	ssw.	33	ssw.	26	nw.	33	wnw.	37	nw.	38
Winter	nw.	27	w.	33	nnw.	31	nnw.	38	w.	41	wnw.	47

GROUP 2

Spring	ssw.	16	wsw.	37	sse.	34	w.	40	wnw.	47	wnw.	36
Summer	s.	13	w.	22	nnw.	23	w.	24	w.	30	w.	32
Autumn	s.	15	wsw.	28	s.	30	nw.	37	nw.	48	nw.	47
Winter	s.	19	sw.	27	nnw.	43	wsw.	35	nw.	58	nw.	81

GROUP 3

Spring	wsw.	18	ssw.	27	ssw.	30	nw.	31	wsw.	33	wnw.	36
Summer	n.	12	nne.	20	sw.	18	wnw.	23	nw.	22	nw.	23
Autumn	s.	11	ssw.	23	wnw.	24	wnw.	32	wnw.	40	w.	53
Winter	w.	15	w.	30	w.	33	wnw.	36	wnw.	48	wsw.	36

GROUP 4

Spring	nw.	18	nw.	37	nw.	42	wnw.	34	nw.	40	wnw.	36
Summer	nw.	15	ssw.	18	sw.	24	ssw.	21	w.	26	n.	23
Autumn	nw.	20	s.	25	s.	36	wsw.	28	wsw.	38	wsw.	37
Winter	nw.	22	wnw.	28	wnw.	36	nw.	38	wnw.	43	wnw.	70

GROUP 5

Spring	se.	20	nw.	32	ssw.	40	sw.	36	wnw.	48	nw.	28
Summer	n.	17	sw.	25	sw.	26	nne.	36	se.	25	n.	27
Autumn	n.	19	nw.	24	nne.	29	w.	31	w.	69	wnw.	26
Winter	nw.	17	wsw.	29	wsw.	35	nw.	42	wnw.	44	wnw.	36

GROUP 6

Spring	wnw.	14	s.	24	sse.	28	nnw.	27	w.	29	w.	32
Summer	sw.	10	s.	15	sw.	19	sw.	20	n.	20	w.	19
Autumn	nw.	11	sw.	19	nw.	29	nw.	26	wnw.	33	wnw.	29
Winter	wsw.	16	s.	22	w.	31	nw.	34	wnw.	45	wnw.	45

GROUP 7

Spring	ne.	13	ne.	18	w.	19	nnw.	25	w.	23	nw.	18
Summer	sw.	12	n.	18	ssw.	16	ese.	17	wsw.	15	ese.	9
Autumn	e.	16	ene.	17	ene.	17	nne.	16	w.	16	w.	15
Winter	w.	21	wnw.	21	wnw.	22	w.	29	w.	20	wsw.	24

GROUP 8

Spring	nnw.	20	nnw.	38	sw.	30	wnw.	34	w.	48	nw.	61
Summer	s.	14	nw.	23	ssw.	31	ssw.	31	nw.	22	nw.	17
Autumn	ssw.	16	ssw.	26	nnw.	23	n.	29	w.	29	w.	37
Winter	s.	19	ssw.	29	sw.	28	ssw.	33	nw.	40	w.	46

GROUP 9

Spring	sse.	19	w.	27	w.	35	wsw.	30	w.	31	w.	33
Summer	nne.	15	sw.	18	sw.	22	w.	16	wsw.	21	w.	18
Autumn	nw.	17	wnw.	23	w.	29	w.	27	nw.	35	w.	26
Winter	w.	20	s.	29	ssw.	28	wnw.	31	w.	32	w.	46

6. *Free-air resultant winds.*—The importance of a knowledge of resultant winds in arranging flight schedules has been shown by previous studies. It has been found, for example (*11*), that the resultant wind at flying levels between New York and Chicago as determined from kite and balloon data, is 7.4 miles per hour from the west, and the records of air mail flights for two years showed that flights eastward were on the average made at a speed of 14.4 m. p. h. faster than flights westward, i. e., the wind factor or resultant wind was 7.2 m. p. h., a striking agreement with the computed value.

Resultant winds for Groups 1 to 9 have therefore been computed and are given in Table 17. The values at 8 and 10 kilometers are based upon too small a number of observations to be considered quantitatively correct, but those from the surface to 6 kilometers are believed to represent very closely the actual conditions. Because of their interest in connection with flight schedules, the values at the surface and at 500 and 1,000 meters above it are shown graphically in Figure 13, the number by each arrow giving the resultant speed for that group. It is interesting to note that the resultant wind for the year at 500 meters between New York and Chicago, taking the average of the values in Groups 2, 3, and 4, is 3.4 m. p. s. or 7.6 m. p. h., again in striking agreement with the results of the air mail study.

The more pronounced features shown in Table 17 and Figure 13 may be summarized as follows:

(1) The resultant direction has a west component at all levels in the Northern States. In the extreme South, Groups 7 and 9, an east component is found from the surface to nearly a kilometer above it during most of the year and at all heights during summer.

(2) The resultant speed at and near the surface is small because there is a fairly equal distribution of all directions, but the speed noticeably increases with height as the individual directions become more and more grouped around west.

(3) There is a pronounced variation in these speeds also with season and with latitude, especially in the higher levels.

Apart from their practical value in connection with flight schedules, resultant winds are of special interest in studies of the larger, general movements of the atmosphere. In fact, if accurately determined from a sufficient amount of data, they indicate exactly the nature of the planetary circulation in the regions which they represent. For this purpose it is essential that the data be given for certain heights above sea level instead of above the surface. Their reduction to sea level has accordingly been made, and the results are presented in Table 18. The values at the surface are of course the same as in Table 17; those at 500 meters differ considerably, particularly for those Groups in which the surface is close to 500 meters above sea level; in the upper levels there is no large difference in the values given in the two tables.

If resultant winds are true indices of the general character of planetary circulation, they should show good agreement with the pressure gradients for corresponding levels. In Figure 14 resultant winds and mean pressures are given for summer, winter and the year at the 500, 1,000, 2,000, and 4,000 meter levels. The pressure curves are taken from Part 1 of this "survey" (*1*) and are based upon observations with kites. Considering that the latter were obtained at only eight stations and that the isobars must necessarily therefore be drawn as sweeping curves, it is evident that in general the resultant directions and pressure gradients conform closely. So far as the velocities are concerned, the following tabulation gives values, as computed from the equation for straight isobars (*12*).

Altitude m.	Summer	Winter	Annual
	M. p. s.	*M. p. s.*	*M. p. s.*
1,000	2.2	5.9	3.7
2,000	3.5	9.6	5.6
4,000	6.0	16.8	10.6

These have been computed from the average distances between the outermost isobars that extend from the Atlantic to the Rocky Mountains, e. g. 898 to 904 at the 1,000-meter level in winter, and so on. Comparing the values above with those entered on Figure 14, we find substantial agreement, except at the 4-kilometer level where the computed values are somewhat higher than are those from the balloon observations, particularly in winter. This is probably owing to the fact that, during observations in high winds, the balloons are frequently carried out of sight before they reach great altitudes. In computing average velocities, this weakness of the pilot-balloon system of observation is eliminated to some extent by employing the differential method, but this can not be used in determining the resultant velocities.

Summarizing the data presented in Tables 17 and 18 and in Figures 13 and 14 we find, in addition to the points already discussed, that, for the country as a whole, there is a south component in the resultant winds at and near the surface, with strongest development in the summer half of the year and in the region between the Rocky Mountains and the Mississippi River. It is least pronounced in the North Atlantic Coast States, where in fact there is a slight north component except in summer and a rapid shift from south component to north immediately above the surface in that season.

At heights above 2 kilometers a north component prevails generally, except over the Florida Peninsula. This indicates a southward trend of the isotherms in the upper levels, particularly in the northern part of the country, and such a trend is shown by observations with kites (*1*).

It has previously been stated that an east component is found during the summer at all levels in southern Texas and the Florida peninsula. As is well known, this region lies in the so-called "horse latitude" belt throughout the year, the maximum pressure being on the average slightly north of it (*13*). An east component therefore prevails in all seasons at and near the surface, but during winter there is a displacement of this high-pressure belt southward in the upper levels, with resulting shift to west component in the winds. In summer, on the other hand, there is evidently no such displacement, since the winds continue easterly up to the greatest heights yet reached; these data confirm the conclusions from theory reached by Shaw and others (*13*). The explanation is of course to be found in the difference in temperature distribution during the two seasons. In winter the normal latitudinal gradient is augmented by the sharp contrast between continental and marine conditions, i. e., the interior of the United States and the water areas southward. The result is a strong temperature and therefore pressure gradient northward, commencing somewhere in the vicinity of the Gulf of Mexico and increasing in intensity as higher latitudes are reached. The belt of high pressure doubtless shifts gradually southward with height from about latitude 30° at the surface to 10° to 20° at 10 to 15 kilometers.

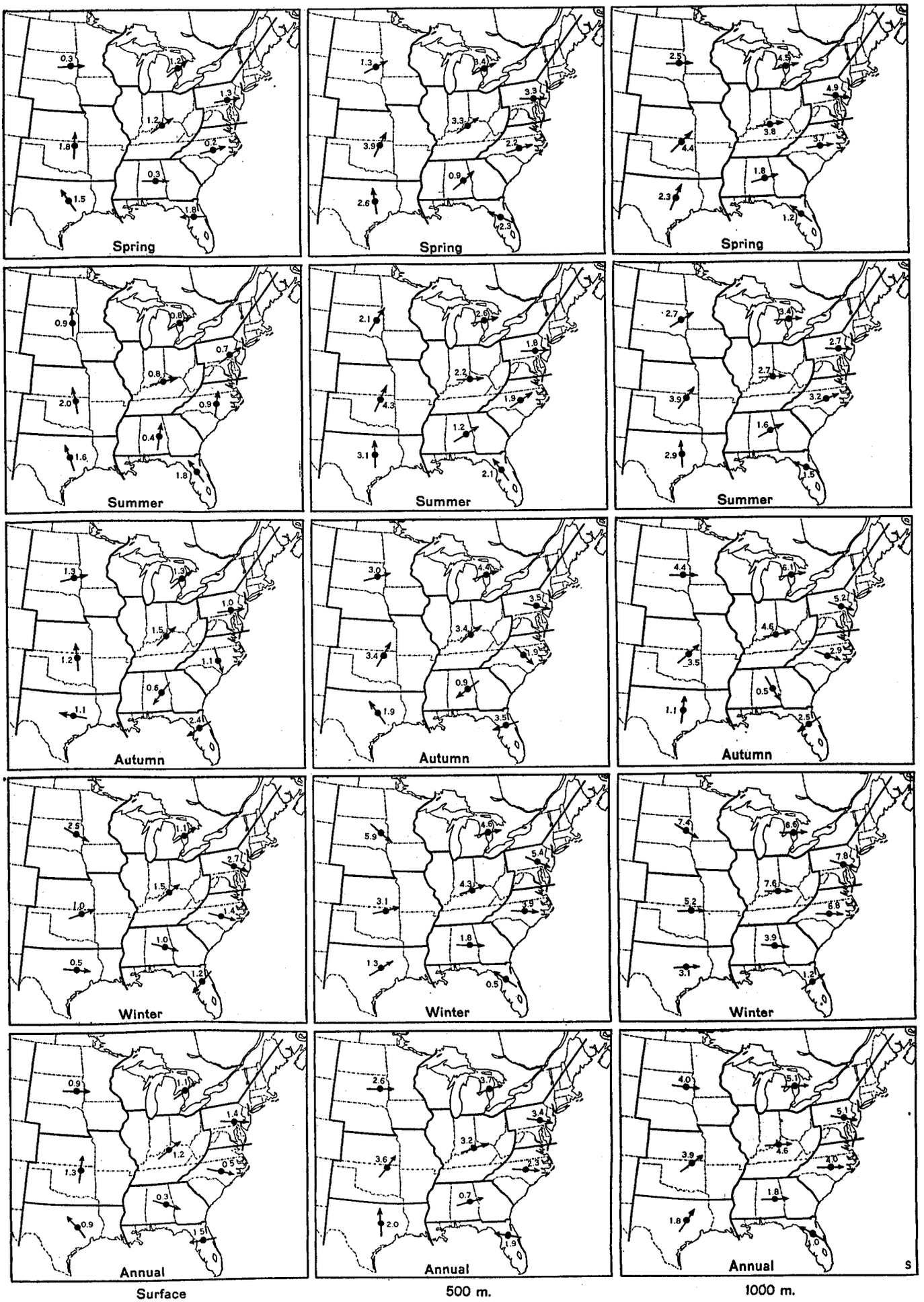

FIG. 13.—Seasonal and annual resultant winds, m. p. s., at the surface and at 500 and 1,000 meters above the surface in eastern and central United States

In summer, on the other hand, the normal latitudinal temperature gradient, small in all regions during that season, is here practically neutralized by the greater heating over the United States than over the Gulf of Mexico. With essentially no temperature gradient with latitude in this region and with surface pressure somewhat higher here than either north or south, it is not surprising to find little shifting of the high pressure belt with increasing altitude.

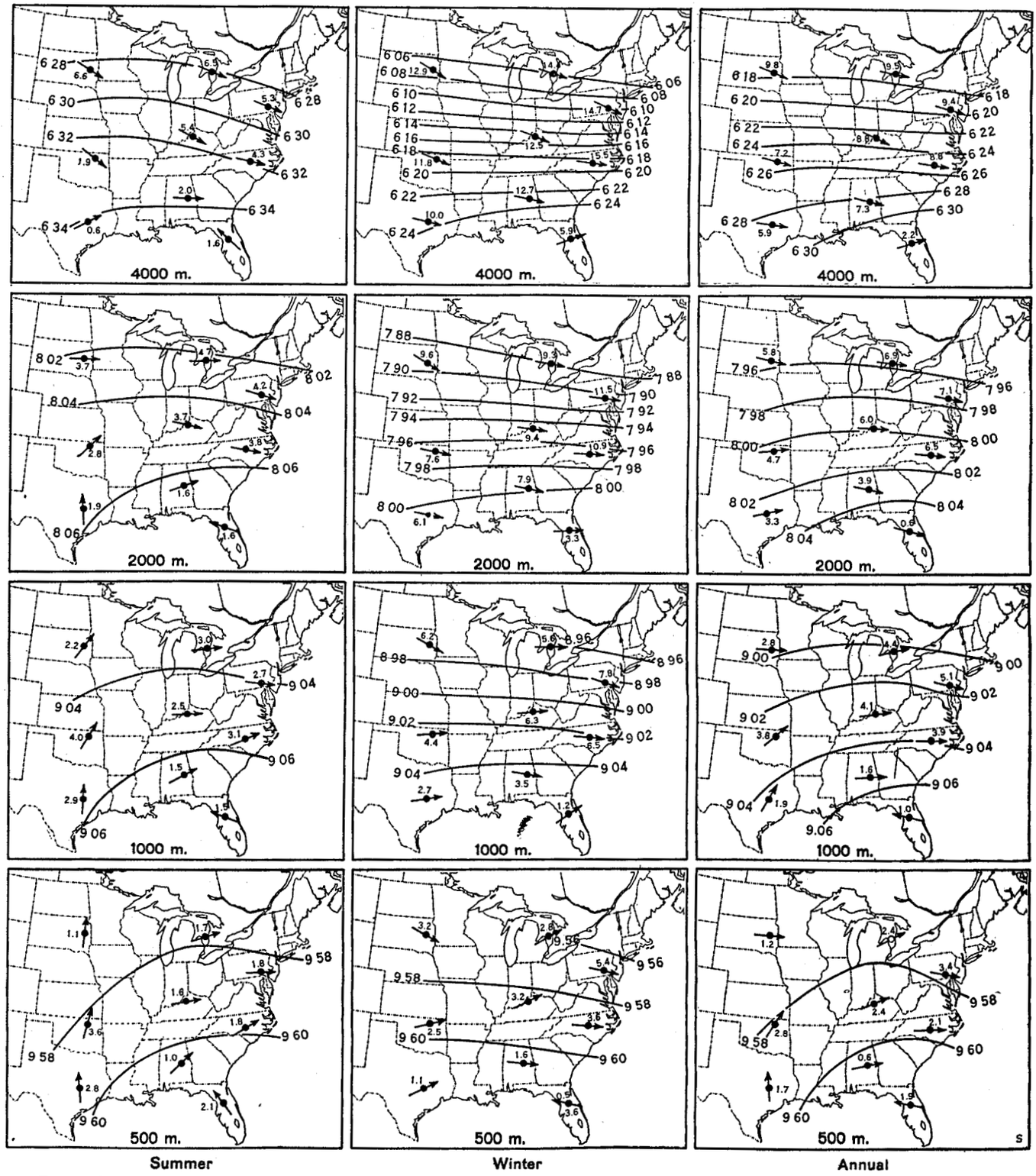

FIG. 14.—Summer, winter, and annual barometric pressures, mb.; and resultant winds, m. p. s., computed therefrom at selected heights above sea level

TABLE 17.—*Average free-air resultant winds, m. p. s., in different parts of the United States*

[Figures in direction columns represent degrees]

GROUP 1

Altitude, meters	Spring		Summer		Autumn		Winter		Annual	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Surface	S. 85 W.	0.3	S. 5 E.	0.9	S. 80 W.	1.3	N. 62 W.	2.5	N. 89 W.	0.9
500	S. 63 W.	1.3	S. 30 W.	2.1	S. 76 W.	3.0	N. 62 W.	5.9	S. 88 W.	2.6
1,000	S. 85 W.	2.5	S. 61 W.	2.7	S. 87 W.	4.4	N. 62 W.	7.4	N. 84 W.	4.0
2,000	N. 86 W.	5.3	N. 75 W.	4.3	N. 80 W.	7.3	N. 66 W.	11.1	N. 75 W.	6.9
3,000	N. 76 W.	8.0	N. 65 W.	6.2	N. 80 W.	9.7	N. 66 W.	11.9	N. 72 W.	8.8
4,000	N. 73 W.	10.1	N. 57 W.	6.9	N. 73 W.	11.5	N. 62 W.	13.5	N. 66 W.	10.2
5,000	N. 69 W.	10.5	N. 58 W.	7.3	N. 70 W.	11.7	N. 69 W.	13.7	N. 67 W.	10.8
6,000	N. 66 W.	10.8	N. 64 W.	9.2	N. 60 W.	12.4	N. 66 W.	14.0	N. 65 W.	11.6
8,000	N. 74 W.	7.4	N. 70 W.	9.7	N. 52 W.	15.7	N. 59 W.	13.4	N. 62 W.	11.4
10,000	N. 74 W.	12.0	N. 55 W.	9.7	N. 46 W.	19.2	N. 76 W.	12.5	N. 61 W.	13.0

GROUP 2

Altitude, meters	Spring		Summer		Autumn		Winter		Annual	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Surface	S. 52 W.	1.2	S. 63 W.	0.8	S. 50 W.	1.3	S. 59 W.	1.1	S. 56 W.	1.1
500	S. 65 W.	3.4	S. 82 W.	2.6	S. 74 W.	4.4	S. 83 W.	4.6	S. 75 W.	3.7
1,000	S. 79 W.	4.5	N. 86 W.	3.4	S. 84 W.	6.1	N. 84 W.	6.6	S. 89 W.	5.1
2,000	N. 86 W.	6.5	N. 74 W.	5.1	N. 84 W.	8.2	N. 76 W.	10.2	N. 80 W.	7.5
3,000	N. 70 W.	8.0	N. 67 W.	6.0	N. 78 W.	9.4	N. 72 W.	13.2	N. 72 W.	9.1
4,000	N. 63 W.	8.3	N. 67 W.	6.7	N. 79 W.	10.3	N. 68 W.	14.8	N. 69 W.	10.1
5,000	N. 58 W.	8.9	N. 63 W.	7.3	N. 70 W.	11.0	N. 64 W.	17.8	N. 64 W.	11.4
6,000	N. 60 W.	9.2	N. 64 W.	6.6	N. 67 W.	10.8	N. 64 W.	18.7	N. 64 W.	11.5
8,000	N. 57 W.	10.2	N. 64 W.	5.5	N. 53 W.	12.8	N. 63 W.	22.1	N. 60 W.	12.6
10,000	N. 65 W.	8.8	N. 37 W.	4.3	N. 57 W.	11.8	N. 61 W.	20.0	N. 58 W.	11.0

GROUP 3

Altitude, meters	Spring		Summer		Autumn		Winter		Annual	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Surface	S. 57 W.	1.2	S. 74 W.	0.8	S. 48 W.	1.5	S. 55 W.	1.5	S. 56 W.	1.2
500	S. 62 W.	3.3	S. 88 W.	2.2	S. 67 W.	3.4	S. 73 W.	4.3	S. 71 W.	3.2
1,000	S. 76 W.	3.8	N. 85 W.	2.7	S. 81 W.	4.6	N. 87 W.	7.6	S. 87 W.	4.6
2,000	N. 82 W.	5.5	N. 73 W.	3.9	W	6.5	N. 78 W.	9.8	N. 81 W.	6.4
3,000	N. 71 W.	7.5	N. 73 W.	4.5	N. 83 W.	8.1	N. 75 W.	11.4	N. 76 W.	7.6
4,000	N. 65 W.	8.5	N. 62 W.	5.6	N. 82 W.	9.2	N. 72 W.	12.8	N. 71 W.	8.9
5,000	N. 63 W.	9.0	N. 64 W.	5.5	N. 84 W.	10.6	N. 70 W.	12.7	N. 71 W.	9.2
6,000	N. 56 W.	9.9	N. 72 W.	5.6	N. 77 W.	10.5	N. 67 W.	13.4	N. 68 W.	9.8
8,000	N. 52 W.	8.6	N. 61 W.	5.2	N. 53 W.	9.4	N. 70 W.	15.1	N. 60 W.	9.5
10,000	N. 52 W.	9.1	N. 47 W.	4.5	N. 26 W.	9.9	N. 60 W.	17.8	N. 49 W.	10.0

GROUP 4

Altitude, meters	Spring		Summer		Autumn		Winter		Annual	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Surface	S. 89 W.	1.3	S. 60 W.	0.7	N. 88 W.	1.0	N. 65 W.	2.7	N. 81 W.	1.4
500	N. 84 W.	3.1	N. 82 W.	1.8	N. 66 W.	3.5	N. 67 W.	5.4	N. 73 W.	3.4
1,000	N. 76 W.	4.9	N. 74 W.	2.7	N. 65 W.	5.2	N. 66 W.	7.8	N. 70 W.	5.1
2,000	N. 69 W.	6.6	N. 65 W.	4.2	N. 68 W.	7.0	N. 72 W.	11.5	N. 68 W.	7.1
3,000	N. 70 W.	7.9	N. 61 W.	5.1	N. 70 W.	8.7	N. 72 W.	14.0	N. 69 W.	8.8
4,000	N. 63 W.	8.6	N. 62 W.	5.3	N. 69 W.	9.0	N. 70 W.	14.7	N. 67 W.	9.4
5,000	N. 68 W.	9.2	N. 63 W.	5.8	N. 62 W.	8.1	N. 71 W.	16.3	N. 67 W.	9.8
6,000	N. 57 W.	8.3	N. 65 W.	5.0	N. 64 W.	9.6	N. 68 W.	19.8	N. 64 W.	10.6
8,000	N. 60 W.	7.8	N. 51 W.	6.5	N. 65 W.	8.0	N. 84 W.	17.7	N. 70 W.	9.8
10,000	N. 57 W.	2.8	N. 53 W.	6.0	N. 55 W.	7.2	N. 63 W.	22.8	N. 60 W.	9.6

GROUP 5

Altitude, meters	Spring		Summer		Autumn		Winter		Annual	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Surface	S. 83 W.	0.2	S. 11 W.	0.9	N. 8 W.	1.1	N. 67 W.	1.4	N. 68 W.	0.5
500	S. 80 W.	2.2	S. 71 W.	1.9	N. 39 W.	1.9	N. 78 W.	3.9	N. 82 W.	2.3
1,000	S. 88 W.	3.7	S. 76 W.	3.2	N. 63 W.	2.9	N. 81 W.	6.8	N. 85 W.	4.0
2,000	N. 80 W.	6.1	N. 70 W.	3.8	N. 66 W.	5.4	N. 78 W.	11.1	N. 75 W.	6.6
3,000	N. 76 W.	7.6	N. 68 W.	4.2	N. 73 W.	6.8	N. 79 W.	13.7	N. 75 W.	8.0
4,000	N. 72 W.	8.8	N. 68 W.	4.3	N. 74 W.	7.6	N. 74 W.	15.6	N. 72 W.	9.1
5,000	N. 66 W.	7.4	N. 68 W.	5.2	N. 72 W.	7.2	N. 75 W.	16.5	N. 71 W.	9.1
6,000	N. 66 W.	7.4	N. 71 W.	5.0	N. 75 W.	7.8	N. 74 W.	17.4	N. 72 W.	9.4
8,000	N. 73 W.	8.7	N. 72 W.	6.9	N. 55 W.	6.3	N. 57 W.	13.0	N. 64 W.	8.5
10,000	N. 76 W.	7.8	N. 87 W.	11.2	N. 48 W.	9.5	N. 30 W.	8.0	N. 63 W.	8.2

GROUP 6

Altitude, meters	Spring		Summer		Autumn		Winter		Annual	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Surface	N. 88 W.	0.3	S. 7 W.	0.4	N. 37 E.	0.6	N. 74 W.	1.0	N. 69 W.	0.3
500	S. 36 W.	0.9	S. 58 W.	1.2	N. 54 E.	0.9	N. 84 W.	1.8	S. 76 W.	0.7
1,000	S. 77 W.	1.8	S. 66 W.	1.6	N. 29 W.	0.5	N. 79 W.	3.9	N. 89 W.	1.8
2,000	N. 79 W.	4.3	S. 75 W.	1.6	N. 70 W.	2.6	N. 76 W.	8.3	N. 78 W.	4.2
3,000	N. 74 W.	6.7	S. 88 W.	2.2	N. 74 W.	3.7	N. 77 W.	10.9	N. 77 W.	5.7
4,000	N. 71 W.	9.0	N. 88 W.	2.0	N. 68 W.	4.8	N. 76 W.	12.9	N. 74 W.	7.4
5,000	N. 67 W.	9.3	N. 58 W.	1.9	N. 73 W.	5.6	N. 76 W.	14.1	N. 71 W.	7.6
6,000	N. 71 W.	10.8	N. 60 W.	2.0	N. 63 W.	5.8	N. 81 W.	14.8	N. 73 W.	8.2
8,000	N. 70 W.	12.8	N. 21 W.	2.7	N. 63 W.	6.0	N. 78 W.	16.7	N. 69 W.	9.1
10,000	N. 48 W.	11.7	N. 34 W.	4.6	N. 55 W.	7.5	N. 80 W.	15.1	N. 61 W.	9.1

TABLE 17.—*Average free-air resultant winds, m. p. s., in different parts of the United States*—Continued

[Figures in direction columns represent degrees]

GROUP 7

Altitude, meters	Spring		Summer		Autumn		Winter		Annual	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Surface	S. 88 E.	1.8	S. 36 E.	1.8	N. 63 E.	2.4	N. 42 E.	1.2	N. 85 E.	1.5
500	S. 63 E.	2.3	S. 36 E.	2.1	N. 76 E.	3.5	S. 67 E.	0.5	S. 74 E.	1.9
1,000	S. 53 E.	1.2	S. 65 E.	1.5	N. 74 E.	2.5	S. 61 W.	1.2	S. 71 E.	1.0
2,000	N. 49 W.	0.9	S. 64 E.	1.6	N. 72 E.	1.0	N. 86 W.	3.3	N. 71 W.	0.6
3,000	N. 63 W.	1.6	S. 70 E.	1.7	S. 61 W.	0.2	S. 77 W.	4.7	S. 86 W.	1.6
4,000	N. 62 W.	2.9	S. 44 E.	1.6	S. 73 W.	1.3	S. 74 W.	5.9	S. 78 W.	2.2
5,000	N. 58 W.	4.2	N. 87 E.	1.8	N. 88 W.	2.8	S. 76 W.	6.5	N. 86 W.	2.7
6,000	N. 66 W.	6.8	S. 72 E.	2.4	N. 61 W.	2.5	S. 73 W.	9.0	N. 82 W.	3.8
8,000	N. 76 W.	13.7	N. 82 E.	2.5	N. 22 W.	2.9	S. 87 W.	11.6	N. 76 W.	6.0
10,000	W.	15.0	N. 58 E.	8.3	N. 25 W.	6.1	N. 70 W.	16.4	N. 59 W.	7.5

GROUP 8

Surface	S.	1.8	S. 13 E.	2.0	S. 8 E.	1.2	S. 74 W.	1.0	S. 4 W.	1.3
500	S. 22 W.	3.9	S. 21 W.	4.3	S. 27 W.	3.4	S. 77 W.	3.1	S. 33 W.	3.6
1,000	S. 44 W.	4.4	S. 29 W.	3.9	S. 49 W.	3.5	S. 86 W.	5.2	S. 54 W.	3.9
2,000	S. 76 W.	5.8	S. 45 W.	2.6	S. 87 W.	4.0	N. 80 W.	8.0	S. 84 W.	4.8
3,000	N. 85 W.	7.3	N. 79 W.	1.8	N. 83 W.	5.7	N. 75 W.	10.6	N. 80 W.	6.3
4,000	N. 77 W.	8.9	N. 49 W.	1.9	N. 79 W.	6.5	N. 73 W.	12.0	N. 74 W.	7.2
5,000	N. 76 W.	10.1	N. 43 W.	2.9	N. 75 W.	7.1	N. 70 W.	12.0	N. 71 W.	7.9
6,000	N. 76 W.	11.0	N. 38 W.	3.2	N. 65 W.	7.5	N. 66 W.	13.1	N. 66 W.	8.6
8,000	N. 75 W.	8.5	N. 43 W.	5.5	N. 58 W.	8.6	N. 54 W.	12.2	N. 58 W.	8.6
10,000	N. 61 W.	12.5	N. 52 W.	5.6	N. 48 W.	10.3	N. 65 W.	8.2	N. 57 W.	9.0

GROUP 9

Surface	S. 34 E.	1.5	S. 24 E.	1.6	S. 79 E.	1.1	N. 87 W.	0.5	S. 36 E.	0.9
500	S. 10 E.	2.6	S. 1 E.	3.1	S. 28 E.	1.9	S. 60 W.	1.3	S. 2 E.	2.0
1,000	S. 19 W.	2.3	S.	2.9	S. 8 W.	1.1	S. 88 W.	3.1	S. 33 W.	1.8
2,000	S. 81 W.	5.6	S. 5 E.	1.8	N. 84 W.	2.0	N. 81 W.	6.4	S. 84 W.	3.4
3,000	N. 86 W.	6.3	S. 10 W.	0.9	N. 77 W.	3.6	N. 82 W.	9.1	N. 85 W.	4.8
4,000	N. 82 W.	8.6	S. 65 W.	0.6	N. 78 W.	4.8	N. 79 W.	10.1	N. 81 W.	6.0
5,000	N. 79 W.	9.2	N. 1 W.	0.3	N. 86 W.	6.8	N. 74 W.	11.3	N. 78 W.	6.8
6,000	N. 77 W.	10.7	N. 10 W.	0.5	N. 73 W.	7.1	N. 65 W.	9.9	N. 71 W.	7.0
8,000	N. 72 W.	13.4	N. 23 E.	1.3	N. 57 W.	6.4	N. 25 W.	8.1	N. 52 W.	6.6
10,000	N. 81 W.	13.6	N. 85 E.	2.6	N. 31 W.	8.6	N. 32 W.	12.0	N. 47 W.	7.2

TABLE 18.—*Average free-air resultant winds, m. p. s., at selected altitudes above sea level in different parts of the United States*

[Figures in direction columns represent degrees]

	Surface		Altitude above m. s. l., meters									
			500		1,000		2,000		4,000		6,000	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
GROUP 1												
Spring	S. 85 W.	0.3	S. 81 W.	0.5	S. 67 W.	1.5	W.	4.2	N. 74 W.	9.3	N. 67 W.	10.7
Summer	S. 5 E.	0.9	S. 2 W.	1.1	S. 36 W.	2.2	S. 87 W.	3.7	N. 60 W.	6.6	N. 62 W.	8.4
Autumn	S. 80 W.	1.3	S. 79 W.	1.6	S. 78 W.	3.3	N. 85 W.	6.1	N. 76 W.	10.8	N. 64 W.	12.1
Winter	N. 62 W.	2.5	N. 62 W.	3.2	N. 62 W.	6.2	N. 64 W.	9.6	N. 64 W.	12.9	N. 67 W.	13.9
Annual	N. 89 W.	0.9	W.	1.2	S. 89 W.	2.8	N. 79 W.	5.8	N. 69 W.	9.8	N. 66 W.	11.3
GROUP 2												
Spring	S. 52 W.	1.2	S. 58 W.	2.3	S. 72 W.	4.0	W	6.0	N. 65 W.	8.2	N. 59 W.	9.1
Summer	S. 63 W.	0.8	S. 72 W.	1.7	S. 88 W.	3.0	N. 77 W.	4.7	N. 67 W.	6.5	N. 64 W.	6.8
Autumn	S. 50 W.	1.3	S. 62 W.	2.8	S. 79 W.	5.2	N. 87 W.	7.7	N. 79 W.	10.1	N. 68 W.	10.9
Winter	S. 59 W.	1.1	S. 71 W.	2.8	W.	5.6	N. 78 W.	9.3	N. 69 W.	14.4	N. 64 W.	18.5
Annual	S. 56 W.	1.1	S. 66 W.	2.4	S. 82 W.	4.4	N. 83 W.	6.9	N. 70 W.	9.5	N. 64 W.	11.3
GROUP 3												
Spring	S. 57 W.	1.2	S. 60 W.	2.5	S. 70 W.	3.6	N. 86 W.	5.2	N. 66 W.	8.3	N. 57 W.	9.7
Summer	S. 74 W.	0.8	S. 82 W.	1.6	N. 88 W.	2.5	N. 75 W.	3.7	N. 64 W.	5.4	N. 70 W.	5.6
Autumn	S. 48 W.	1.5	S. 59 W.	2.6	S. 75 W.	4.1	S. 88 W.	6.1	N. 82 W.	9.0	N. 78 W.	10.5
Winter	S. 55 W.	1.5	S. 66 W.	3.2	S. 85 W.	6.3	N. 80 W.	9.4	N. 73 W.	12.5	N. 68 W.	13.3
Annual	S. 56 W.	1.2	S. 65 W.	2.4	S. 80 W.	4.1	N. 84 W.	6.0	N. 72 W.	8.8	N. 68 W.	9.8
GROUP 4												
Spring	S. 89 W.	1.3	N. 84 W.	3.1	N. 76 W.	4.9	N. 69 W.	6.6	N. 63 W.	8.6	N. 57 W.	8.3
Summer	S. 60 W.	0.7	N. 82 W.	1.8	N. 74 W.	2.7	N. 65 W.	4.2	N. 62 W.	5.3	N. 65 W.	5.0
Autumn	N. 88 W.	1.0	N. 66 W.	3.5	N. 65 W.	5.2	N. 68 W.	7.0	N. 69 W.	9.0	N. 64 W.	9.6
Winter	N. 65 W.	2.7	N. 67 W.	5.4	N. 66 W.	7.8	N. 72 W.	11.5	N. 70 W.	14.7	N. 68 W.	19.8
Annual	N. 81 W.	1.4	N. 73 W.	3.4	N. 70 W.	5.1	N. 68 W.	7.1	N. 67 W.	9.4	N. 64 W.	10.6
GROUP 5												
Spring	S. 83 W.	0.2	S. 80 W.	2.0	S. 87 W.	3.6	N. 81 W.	6.0	N. 72 W.	7.7	N. 66 W.	7.4
Summer	S. 11 W.	0.9	S. 65 W.	1.8	S. 75 W.	3.1	N. 72 W.	3.8	N. 68 W.	4.3	N. 71 W.	5.0
Autumn	N. 8 W.	1.1	N. 36 W.	1.8	N. 61 W.	2.8	N. 66 W.	5.3	N. 74 W.	7.6	N. 75 W.	7.8
Winter	N. 67 W.	1.4	N. 77 W.	3.6	N. 81 W.	6.5	N. 78 W.	10.9	N. 74 W.	15.5	N. 74 W.	17.4
Annual	N. 68 W.	0.5	N. 82 W.	2.1	N. 85 W.	3.9	N. 75 W.	6.5	N. 74 W.	8.8	N. 72 W.	9.4
GROUP 6												
Spring	N. 88 W.	0.3	S. 47 W.	0.8	S. 69 W.	1.6	N. 79 W.	4.0	N. 71 W.	8.8	N. 71 W.	10.7
Summer	S. 7 W.	0.4	S. 48 W.	1.0	S. 64 W.	1.5	S. 74 W.	1.6	N. 88 W.	2.0	N. 60 W.	2.0
Autumn	N. 37 E.	0.6	N. 51 E.	0.8	N. 12 W.	0.6	N. 66 W.	2.4	N. 69 W.	4.7	N. 74 W.	5.8
Winter	N. 74 W.	1.0	N. 82 W.	1.6	N. 80 W.	3.5	N. 76 W.	7.9	N. 76 W.	12.7	N. 80 W.	14.7
Annual	N. 69 W.	0.3	S. 78 W.	0.6	W.	1.6	N. 78 W.	3.9	N. 74 W.	7.3	N. 74 W.	8.2
GROUP 7												
Spring	S. 88 E.	1.8	S. 63 E.	2.3	S. 53 E.	1.2	N. 49 W.	0.9	N. 62 W.	2.9	N. 66 W.	6.8
Summer	S. 36 E.	1.8	S. 36 E.	2.1	S. 65 E.	1.5	S. 64 E.	1.6	S. 44 E.	1.6	S. 72 E.	2.4
Autumn	N. 63 E.	2.4	N. 76 E.	3.5	N. 74 E.	2.5	N. 72 E.	1.0	S. 73 W.	1.3	N. 61 W.	2.5
Winter	N. 42 E.	1.2	S. 67 E.	0.5	S. 61 W.	1.2	N. 86 W.	3.3	S. 74 W.	5.9	S. 73 W.	9.0
Annual	N. 85 E.	1.5	S. 74 E.	1.9	S. 71 E.	1.0	N. 71 W.	0.6	S. 78 W.	2.2	N. 82 W.	3.8
GROUP 8												
Spring	S.	1.8	S. 15 W.	3.3	S. 37 W.	4.3	S. 71 W.	5.6	N. 78 W.	8.7	N. 76 W.	10.9
Summer	S. 13 E.	2.0	S. 11 W.	3.6	S. 27 W.	4.0	S. 43 W.	2.8	N. 53 W.	1.9	N. 39 W.	3.2
Autumn	S. 8 E.	1.2	S. 16 W.	2.7	S. 42 W.	3.5	S. 81 W.	3.9	N. 80 W.	6.4	N. 67 W.	7.4
Winter	S. 74 W.	1.0	S. 76 W.	2.5	S. 83 W.	4.4	N. 82 W.	7.6	N. 73 W.	11.8	N. 67 W.	12.9
Annual	S. 4 W.	1.3	S. 26 W.	2.8	S. 48 W.	3.8	S. 80 W.	4.7	N. 75 W.	7.2	N. 67 W.	8.5
GROUP 9												
Spring	S. 34 E.	1.5	S. 15 E.	2.4	S. 13 W.	2.4	S. 75 W.	5.3	N. 82 W.	8.4	N. 77 W.	10.6
Summer	S. 24 E.	1.6	S. 6 E.	2.8	S.	2.9	S. 4 E.	1.9	S. 60 W.	0.6	N. 9 W.	0.5
Autumn	S. 79 E.	1.1	S. 38 E.	1.7	S. 1 W.	1.3	S. 87 W.	1.9	N. 78 W.	4.7	N. 74 W.	7.1
Winter	N. 87 W.	0.5	S. 67 W.	1.1	S. 82 W.	2.7	N. 82 W.	6.1	N. 79 W.	10.0	N. 66 W.	10.0
Annual	S. 36 E.	0.9	S. 8 E.	1.7	S. 25 W.	1.9	S. 79 W.	3.3	N. 81 W.	5.9	N. 71 W.	7.0

LITERATURE CITED

(*1*) GREGG, W. R.
1922. AN AEROLOGICAL SURVEY OF THE UNITED STATES. PART I. RESULTS OF OBSERVATIONS BY MEANS OF KITES. Mo. Wea. Rev. Supp. No. 22. W. B. 768.

(*2*) GREGG, W. R., and others.
1921. INSTRUCTIONS FOR AEROLOGICAL OBSERVERS. W. B. 740.

(*3*) SHERRY, B. J.
1920. THE RATE OF ASCENT OF PILOT BALLOONS. Mo. Wea. Rev., 48:692.

(*4*) HAINES, W. C.
1924. ASCENSIONAL RATE OF PILOT BALLOONS. Mo. Wea. Rev., 51:249.

(*5*) SAMUELS, L. T.
1926. A SUMMARY OF AEROLOGICAL OBSERVATIONS IN WELL-PRONOUNCED HIGHS AND LOWS. Mo. Wea. Rev. 54:195.

(*6*) HUMPHREYS, W. J.
1925. THE WAY OF THE WIND. Journ. of the Franklin Inst., Vol. 200, No. 3:279.

(*7*) RILEY, J. A.
1923. THE WINDS OF OKLAHOMA AND EAST TEXAS. Mo. Wea. Rev., 51:453.

(*8*) ROUCH, J.
1919. THE DIURNAL VARIATION OF WIND VELOCITY IN THE FREE AIR. Mo. Wea Rev., 47:708 (Abstract by C. L. Meisinger from *Comptes Rendus*, Paris Acad. Aug. 11, 1919, pp. 293–295.

(*9*) RILEY, J. A.
1926. THE WIND FACTOR AND THE AIR MAIL SOUTHWARD FROM KANSAS CITY. Mo. Wea. Rev., 54:10.

(*10*) MEISINGER, C. L.
1922. THE PREPARATION AND SIGNIFICANCE OF FREE-AIR PRESSURE MAPS FOR THE CENTRAL AND EASTERN UNITED STATES. Mo. Wea. Rev. Supp. No. 21, W. B. 784, p. 22.

(*11*) GREGG, W. R. and VAN ZANDT, J. P.
1923. THE WIND FACTOR IN FLIGHT: AN ANALYSIS OF ONE YEAR'S RECORD OF THE AIR MAIL. Mo. Wea. Rev., 51:111.
1924. THE FREQUENCY OF WINDS OF DIFFERENT SPEEDS AT FLYING LEVELS BETWEEN NEW YORK AND CHICAGO: A FURTHER ANALYSIS OF THE AIR MAIL SERVICE. Mo. Wea. Rev., 52:153.

(*12*) HUMPHREYS, W. J.
1920. PHYSICS OF THE AIR: 140.

(*13*) SHAW, SIR NAPIER.
1923. THE AIR AND ITS WAYS. Plates XIV, XV, XVIII, XX, and XXI. Cambridge University Press, London.

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