IS OUR SNOWFALL DECREASING?

by

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Abstract

The 72-year Blue Hill seasonal snowfall record ranges from 13 to 136 inches, in 10-year averages from 46 to 67, and in 30-year averages from 54 to 62. Although snowy and open winters are scattered throughout, the last 36 seasons averaged 2.5 inches less than the first 36 seasons.

Introduction

In answering the question set forth in the title of this paper, the author encountered other questions regarding trends in snowfall and snowcover which are often asked by the layman. For instance "What has become of 'the good old winters'?" and "Are our winters beginning later and ending later?" Attempts have been made to answer these and other related questions.

It should be noted that this discussion is based solely on Blue Hill records and any comparisons to be made with other points in the Northeast should be made with caution. It has been shown by Conover (1951) and Putnins (1955) that the trends in temperature and precipitation at Blue Hill closely parallel those of other stations in southern New England.

The records of Blue Hill are excellent for a study of this type from the standpoint of relative homogeneity with other stations and the homogeneity of its own records.

In the data to be presented, the reader will find that trace (T) and 0.3 inch are often used as criteria in comparisons made by the author. These particular measurements have been used to make the data homogeneous. Snow measurements have been made in quarters of inches as well as tenths and T has stood for patches, less than ¼ inch, and less than 0.05 inch at various times in the Blue Hill records.

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Snowfall

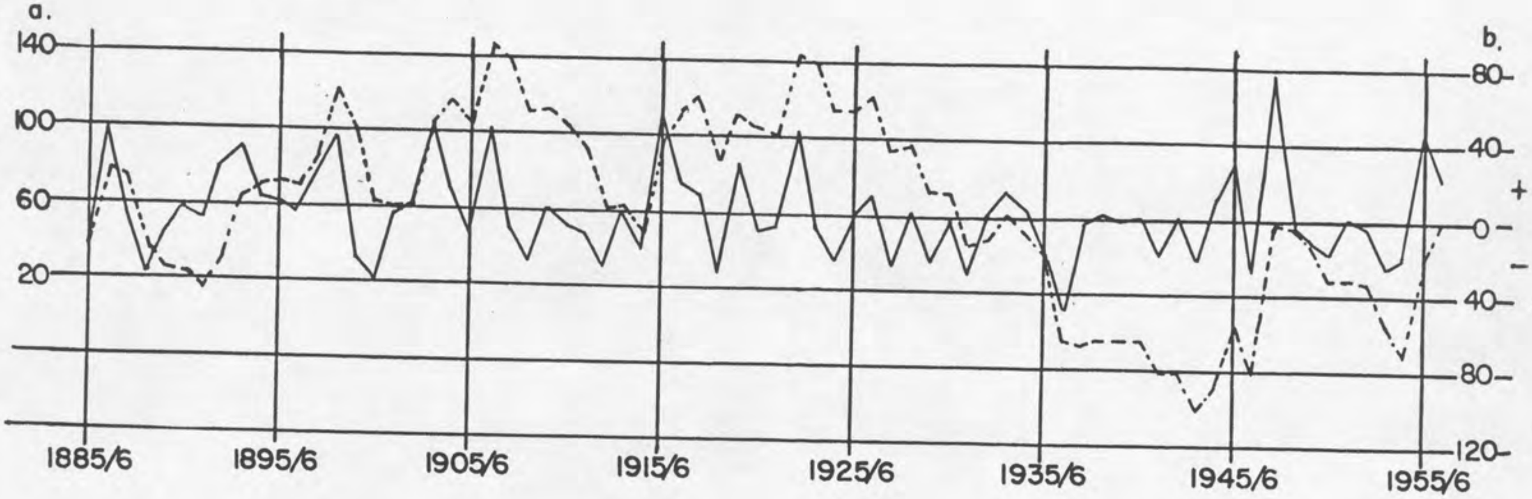

Fig. 1 Annual snowfall and cumulative deviation from the mean annual snowfall. (a) Annual totals of snowfall. (b) Cumulative deviation from the mean annual snowfall.

Although annual snowfall amounts as plotted in Figure 1 show little apparent trend, the cumulative deviation from the mean annual snowfall (58.8 inches) indicates above normal snowfall from the beginning of record to 1922/23. The subnormal snowfall of the following 21 years accounts for the decline of the cumulative deviation line. Since 1943/44, there have been four winters with snowfalls of over 80 inches. These have helped to increase the cumulative deviation. Each of the last two winters had over 80 inches of snow. This was the first time that two consecutive winters had that much snow. The snowiest winter on record was the 1947/48 season with 136.0 inches and the 1936/37 winter with 12.6 inches had the least snow. The last 36 seasons averaged 2.5 inches less snow than the first 36 seasons.

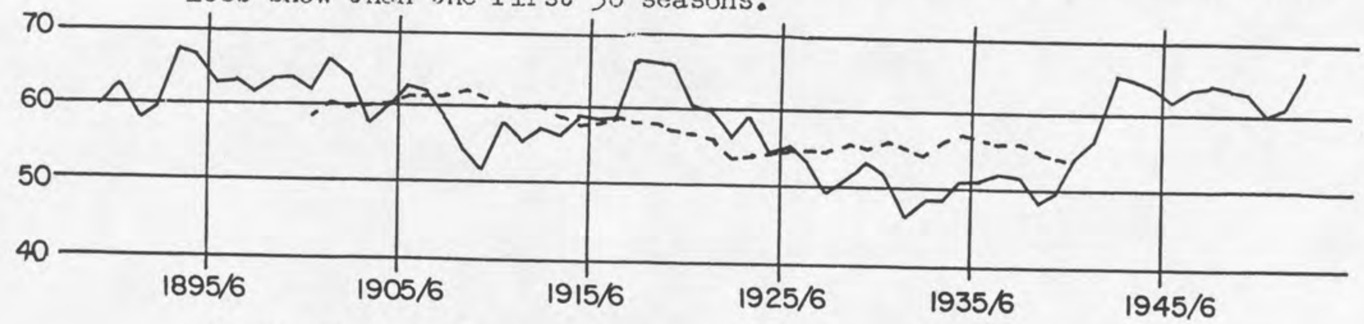

Fig. 2 10- and 30-year moving means of annual snowfall.

The 10- and 30-year moving means (Fig. 2) give the best indication of the trends. Ignoring for the moment the minor fluctuations in the 10-year moving mean line, one sees immediately a downward trend in snowfall until the early 30's. Since then, a sharp increase occurred followed by a more uniform period. During this latter period, there have been 11 consecutive moving 10-year means of snowfall (1942/43 through 1952/53) that have totaled more than 60.0 inches. This happened once before in the period 1892/93-1902/03. One looking for cycles might ask if the recent upward trend is the start of a long cycle or one in a series of shorter ones. The longer cycle would be about 80-90 years and the shorter ones about 25 years. The recognized sunspot cycle of 23 years would fit the shorter snowfall cycles very closely except that the sunspot cycle has been in the order of 20 years for the past 3 maxima. Thus, there appears to be no relationship between the apparent snowfall cycle and the sunspot cycle.

The 30-year moving mean shows very much the same pattern as the 10-year moving mean. After a slight rise for the first few means to a maximum of 62.4 inches, a general decline for the next 14 means resulted in the lowest average (53.9 inches) in the record. The past 20 means have centered around the 56 inch line with little fluctuation.

From the discussion above, the answer to the question posed by the title of this paper is "No". Nor could one readily say that the snowfall was increasing in amount. Whether the trend will be generally upward or downward in the immediate future is difficult to determine. The lack of a well-defined cycle limits one's ability to forecast from past performance and the recent relative stability of the 10- and 30-year moving means of snowfall further complicate the picture. The past 18 years of relatively snowy winters resemble the 18-year period ending 1911/12. Twelve of the eighteen snowiest winters occurred during these two periods totaling 36 years. In the same periods, only 5 of the 18 least snowy seasons occurred. If history repeats itself, we may expect the next 30 winters to average somewhat less snow than the past 18. That is not to say that we will not experience some severe winters. During 36 years of generally less snowy winters were two of the six winters on record with more than 100 inches of snowfall.

Table I is presented to give the reader an idea of the number of snow storms of varying amounts that might be expected in a season. It was felt that by taking the frequencies of total snowfall in any two consecutive days a better representation of actual storm totals might be had. The reason for this is that a day with precipitation (in the months October-May) is more likely to be followed by another with precipitation than without at Blue Hill.

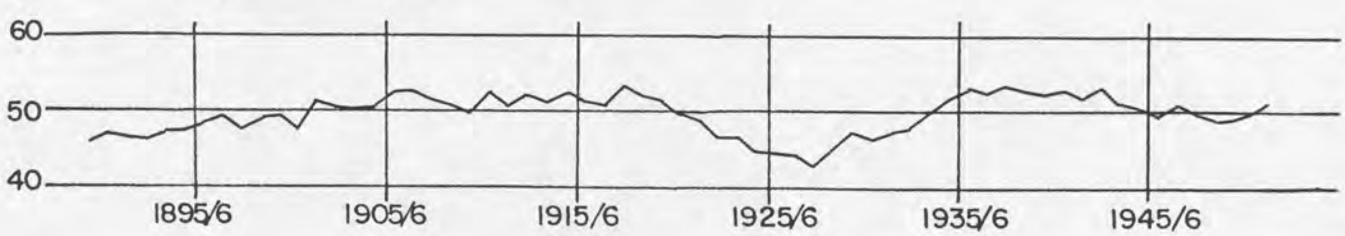

Fig. 2a Seasonal days with snowfall equal to or greater than T.

During the 1936/37 winter, there was but one storm which deposited as much as 3 inches while during the winter of 1947/48 there were 16. Nine of these left 6 inches or more and 4 dropped over 12 inches. There were two storms which left as much as 18 inches during the 1945/46 season. This

Table I

Frequencies of snowfalls in any two consecutive days equal to or greater than the noted amounts.

	≥ 3"	≥ 6"	≥ 12"	≥ 18"
1886/87	12	7	2	
1887/88	6	1		
1888/89	3	1		
1889/90	2	1		
1890/91	5	4	1	
1891/92	6	4		
1892/93	9	4	1	
1893/94	12	5	2	
1894/95	11	3		
1895/96	8	4		
1896/97	8	4	1	
1897/98	10	4	1	1
1898/99	13	5	2	
1899/00	3	2	1	
1900/01	3	1		
1901/02	7	3	1	
1902/03	6	3	1	1
1903/04	12	5	2	1
1904/05	7	4	1	
1905/06	7	4		
1906/07	14	4	1	
1907/08	8	3		
1908/09	3	1		
1909/10	6	3	1	1
1910/11	5	3		
1911/12	7	2		
1912/13	3	2		
1913/14	6	4		
1914/15	5	1		
1915/16	11	8	2	
1916/17	7	4	1	
1917/18	9	4		
1918/19	2	2		
1919/20	10	6	1	
1920/21	5	2	1	1
1921/22	6	3		
1922/23	13	5	1	
1923/24	5	3	1	
1924/25	5	1		
1925/26	6	2	2	
1926/27	6	5	1	
1927/28	3	2		
1928/29	10	2	1	
1929/30	5			
1930/31	7	4		
1931/32	3	2		
1932/33	7	4	1	
1933/34	7	6	1	
1934/35	8	2	1	
1935/36	4	2	1	
1936/37	1			
1937/38	7	4		
1938/39	6	3	1	
1939/40	5	4	1	
1940/41	6	4	1	
1941/42	7	2		
1942/43	9	5	1	
1943/44	4	2	1	
1944/45	11	2	1	
1945/46	7	6	2	
1946/47	4	1		
1947/48	16	9	4	
1948/49	8	3		
1949/50	6	3	1	
1950/51	4	2		
1951/52	9	4		
1952/53	7	5		
1953/54	3	1	1	
1954/55	4	2	1	
1955/56	9	7	4	1
1956/57	11	4	1	
means	6.9	3.3	0.8	0.1

was especially remarkable when one considers that on the average one winter in ten has such a storm.

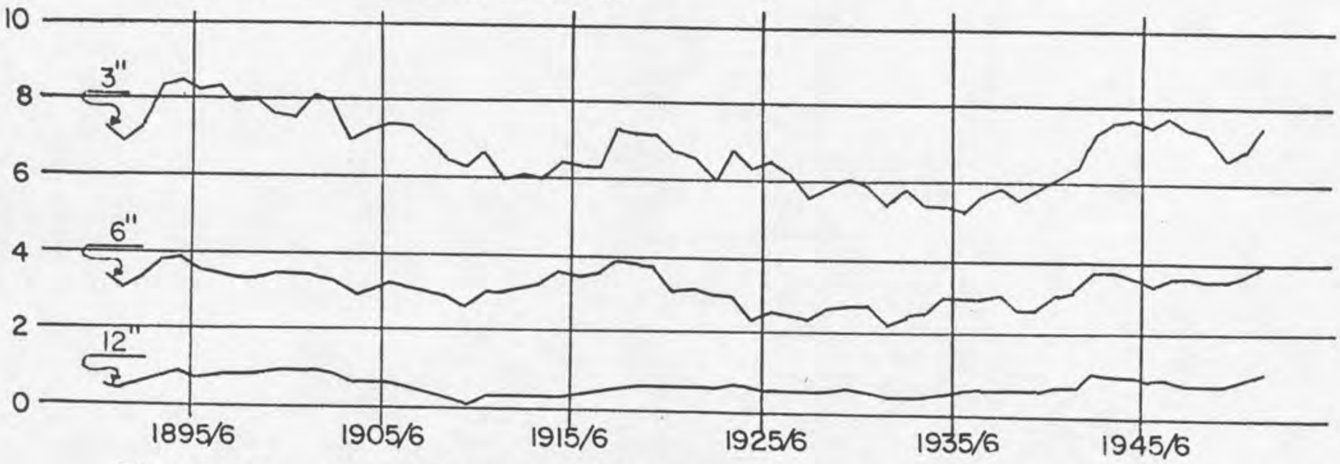

Fig. 3 Ten-year moving means of frequencies of snowfalls equal to or greater than the noted amounts in any two consecutive days.

The 10-year moving mean of the frequency of 3 inch snowfalls in Figure 3 shows very nearly the same characteristics as the 10-year moving mean line in Figure 2. This is to be expected in that of all storms which have 3 or more inches of snow, less than half of them have as much as 6 inches. Thus, the number of 3 inch falls is indicative of a season's total. There are exceptions to this, of course, e. g., of the nine winters with more than 90 inches of snow, all but two had more than 10 three-inch falls. The two which did not are still remembered in New England for their adversity. The winter of 1945/46 had only 7 storms which deposited as much as 3 inches of snow. Two of these seven, however, were the storms which left over 18 inches. The 1955/56 season with its March and April blizzards is the second season with less than 10 three-inch snowfalls. The populace of the Northeast reeled under the weight of five major storms in a period of a month, 3 of which resulted in 12 or more inches of snow at Blue Hill. There were but 9 equal to or greater than 3 inches during the winter.

The 10-year moving means of the frequencies of the 6 and 12 inch amounts show nearly the same trends as the 3 inch curve. It is felt that the conclusion drawn for the trend in snowfall in recent years will hold for the trends in snowfalls of various amounts. There have been winters with very much and others with very little snow scattered through the record and the same applies to storms with various amounts. Whether there is a tendency toward winters with bigger storms one cannot say anymore than he could state categorically that we are due for more or less snowy winters than in the past.

There is an apparent direct relationship between the 10-year moving mean temperatures of December, January, and February and the 10-year moving means of annual snowfalls. It has been calculated that for the months October through May, departure from the mean temperature and snowfall were of the opposite sign in 64 percent of all cases. Though it cannot confidently be said that one definitely influences the other, there certainly is more than a chance relationship.

Snowcover

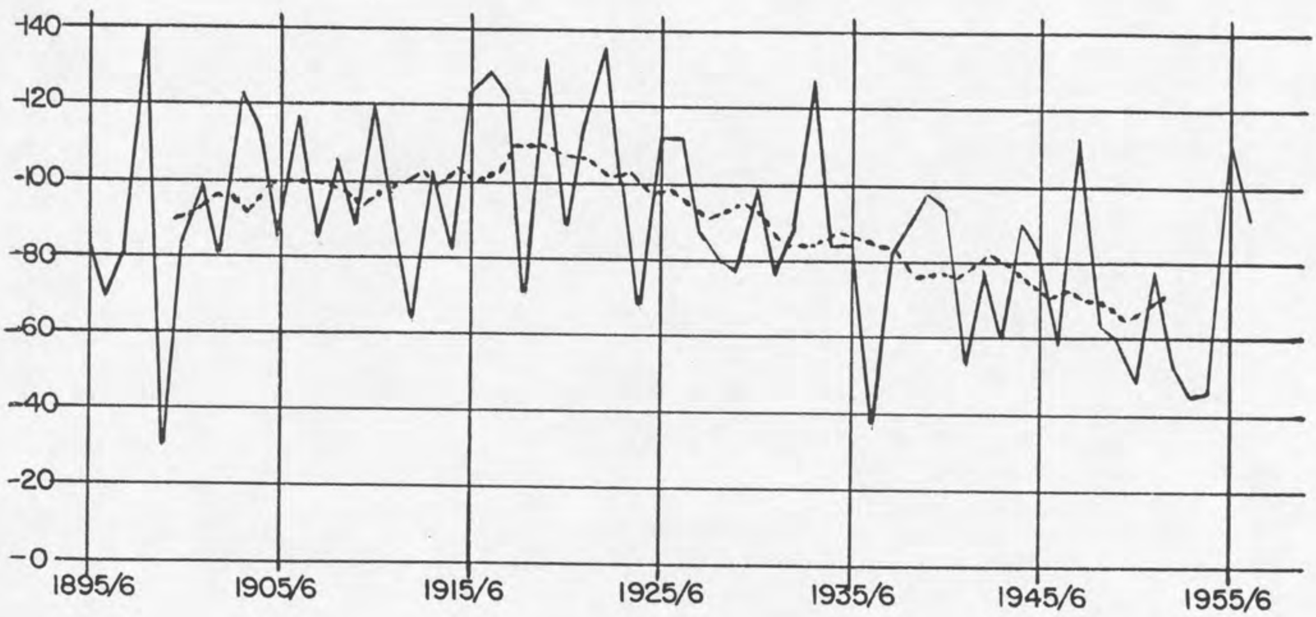

Fig. 4 Seasonal days with snowcover equal to or greater than T.

The very obvious trend of the 10-year moving mean seasonal days with snowcover equal to or greater than T (Fig. 4) shows little resemblance to the 10-year moving mean in Figure 2. One of several maxima in the latter curve occurred in the decade ending 1922/23. This decade accounted for the only maximum in the former curve. The early record shows a gradual increase in the number of days with a trace or more of snowcover until this maximum and since that time there has been a steady, relatively unbroken decline. There was an average of 13.6 fewer days per season with a trace or more of snowcover in the last half of the record than in the first.

There have not been more than two consecutive increases in the decadal means since the decade ending 1922/23. It is interesting to note that the last two decadal means have shown increases. For a third increase, the present season must have at least 114 days with snowcover equal to or greater than T. To the first of February, there have been 29 such days so that the prospects for a continuance of the upward trend are practically nil. The smallest decadal mean was 65.3 days and occurred two means ago. Forty-nine or less days this season will result in a new low decadal mean.

The very interesting and perplexing discontinuities noted earlier between Figure 2 and Figure 4 may perhaps be best explained as due to the higher temperatures of the past 34 years. The lowest 10-year mean temperature occurred with the decade ending 1922/23. This was the decade with the most seasonal days with snowfall equal to or greater than T (Fig. 2a) and also the decade with most seasonal days with snow-cover equal to or greater than T. Since that time, the mean temperatures increased over 3° until the decade ending 1932/33. The succeeding 16 means show a decrease of about 2°. The last 8 decadal means have shown a phenomenal increase to the present record high 10-year mean winter temperature of 28.6° (See Table II). When one compares this temperature record since 1922/23 with the snowfall and snowcover records, he finds a slight correlation. The decrease and subsequent increase in the number of seasonal days with snowfall equal to or greater than T between the decades ending 1922/23 and 1940/41 corresponds very well with the increase and later decrease in the mean winter temperatures. Since the 1940/41 decade, a relatively stable number of days with snowfall has occurred with both low and high temperature means. The 10-year moving means of annual snowfall show almost no correlation with the temperatures since 1922/23. In that the overall trend of temperatures over the past 34 years has been upward, one might say the decrease in the number of days per season with snowcover equal to or greater than T is due to the increase in temperature. The various fluctuations in the mean decadal temperatures are only occasionally reflected in the snowcover days, so one could argue that although temperatures may affect the seasonal snowcover days to some extent, other influences must also prevail. This fact is acknowledged by the author but he has little in the way of data with which to back his belief.

Certainly, the presence of soot on the snow and consequent increase in solar radiation absorbtivity must have some effect. Though Blue Hill Observatory is located several miles south of Boston, there is definitely some accumulation. Conover has related incidents of the accumulation of wind-driven soot on new surfaces on top of the observatory in a matter of a few days. Since the change of soot deposits at Blue Hill over the years is unknown, the magnitude of this effect in reducing snow-cover is unknown. The direction of the change, however, is almost surely toward more soot and, therefore, more rapid melting.

What the variation in insolation has been over the past 34 years is not known, but it is a fact that an increase in the total should also affect the number of snowcover days.

Wind is another factor which affects snowcover. It is possible that an increase in storminess resulting in more snow could also produce

Table II

Annual means and 10-year moving means of the Dec., Jan., and Feb. mean temperatures.

	(1)	(2)		(1)	(2)		(1)	(2)
1885/86	25.2		1909/10	26.3	25.3	1933/34	21.1	27.7
1886/87	23.0		1910/11	24.8	25.3	1934/35	23.8	27.4
1887/88	23.4		1911/12	24.9	25.2	1935/36	22.1	26.9
1888/89	27.8		1912/13	31.3	25.7	1936/37	32.3	27.4
1889/90	31.8		1913/14	26.3	26.2	1937/38	27.0	27.3
1890/91	26.7		1914/15	27.9	26.9	1938/39	28.4	27.3
1891/92	29.3		1915/16	25.4	26.5	1939/40	25.0	27.0
1892/93	22.2		1916/17	25.5	26.8	1940/41	26.6	26.9
1893/94	26.0		1917/18	20.3	26.1	1941/42	26.8	26.5
1894/95	25.0	26.0	1918/19	27.7	26.0	1942/43	25.0	25.8
1895/96	26.4	26.2	1919/20	19.8	25.4	1943/44	26.5	26.3
1896/97	26.1	26.5	1920/21	27.1	25.6	1944/45	24.5	26.9
1897/98	28.1	26.9	1921/22	25.1	25.6	1945/46	25.3	26.7
1898/99	25.2	26.7	1922/23	21.4	24.6	1946/47	28.7	26.4
1899/00	28.5	26.4	1923/24	27.9	24.8	1947/48	23.4	26.0
1900/01	24.4	26.1	1924/25	26.8	24.7	1948/49	31.8	25.7
1901/02	26.1	25.8	1925/26	27.1	24.9	1949/50	30.3	26.2
1902/03	26.5	26.2	1926/27	27.1	25.0	1950/51	30.9	26.6
1903/04	20.5	25.7	1927/28	28.4	25.8	1951/52	30.4	27.0
1904/05	20.9	25.3	1928/29	28.6	25.9	1952/53	31.9	27.7
1905/06	29.8	25.6	1929/30	28.3	26.8	1953/54	31.1	28.1
1906/07	22.3	25.2	1930/31	26.8	26.8	1954/55	28.0	28.5
1907/08	27.6	25.2	1931/32	30.8	27.3	1955/56	26.4	28.6
1908/09	28.2	25.5	1932/33	32.3	28.4	1956/57	28.3	28.6

(1) Annual means
(2) 10-year moving means (decade ending)

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higher winds. Strong winds, when accompanied by above freezing temperatures, cause rapid melting. The recent wind averages, however, have not increased appreciably. It is not known what changes, if any, have taken place with above freezing temperatures.

Reviewing briefly, we have the following situation. Over the past 10-15 years, we have had more days with snowfall than during the preceding 20 years, a relative increase in the number of larger storms and, understandably enough, an increase in the decadal means of annual snowfall. And yet, in that same period, there has been a decrease in the decadal mean number of days with snowcover equal to or greater than T of about 15 days. Inferring again that temperature is the reason for this, let us consider another possibility. It has been suggested that this phenomenon might be characteristic of those places whose mean winter temperatures are relatively near 32°F. If the mean winter temperature was 10° lower, perhaps there would not be this continued downward trend in snowcover days. This is pure speculation but it has its merits. It is possible, then, to explain that even with the gradual decrease in the winter temperatures between the decades ending 1932/33 and 1948/49, the mean for the whole period was still sufficiently high to result in a decrease in snowcover days. The 10-year moving mean number of days per season with snowcovers equal to or greater than 3, 6, and 12 inches compares quite closely with the values in Figure 3. In support of the above theory, then, we can say that the temperature factor, perhaps while having some influence on the snowcovers of greater depths, has more effect on the new accumulations of very light snow. While there has been a relatively large number of days with snowfall in the past 15 years, the higher temperatures have tended to melt the snow from lesser storms more rapidly, resulting in fewer days with snowcover of smaller amounts.

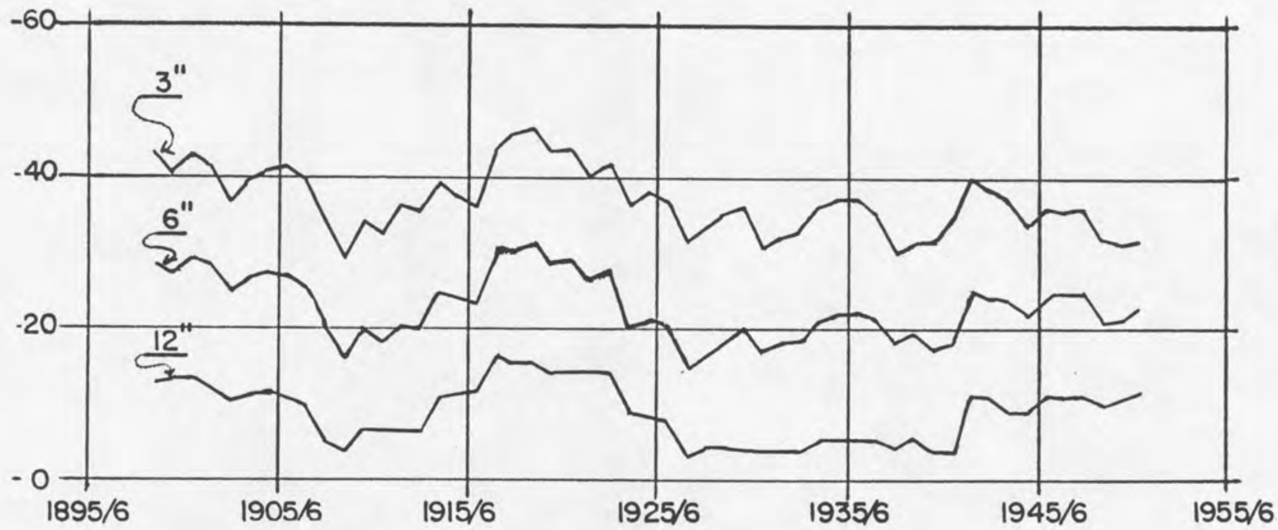

Fig. 5 Ten-year moving mean number of days per season with snowcover equal to or greater than the noted amounts.

Table III gives the frequencies of days per season with snow on the ground of various amounts. When comparing the snowcover values in Figure 5 with the values of Table II, winter mean temperatures, one finds that there is a very obvious interrelationship until the last 5 or 6 means of the 6 and 12 inch depths. Whether the low temperatures are responsible for

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Table III

Frequencies of days per season with snow on the ground equal to or greater than the noted amounts.

	3"	6"	12"	18"	24"	30"	36"		3"	6"	12"	18"	24"	30"	36"
1895/96	52	27	4					1927/28	13	4					
1896/97	36	25	7					1928/29	31	15	1				
1897/98	30	20	11	5	3			1929/30	14						
1898/99	65	37	19	6	3			1930/31	37	17					
1899/00	11	7	1					1931/32	16	3					
1900/01	23	6						1932/33	42	20	3				
1901/02	35	22	5					1933/34	58	33	12	4			
1902/03	36.	25	8	1				1934/35	46	32					
1903/04	77	70	63	21	3			1935/36	52	51	24	3			
1904/05	67	46	12					1936/37	1						
1905/06	25	14	6					1937/38	27	15					
1906/07	63	47	9	5				1938/39	40	16	4				
1907/08	16	8						1939/40	43	27	16				
1908/09	14	5						1940/41	46	28					
1909/10	41	23	10					1941/42	18	4					
1910/11	36	16						1942/43	23	9	2				
1911/12	38	18						1943/44	9	5					
1912/13	20	7						1944/45	59	45	14	1			
1913/14	23	17	15	7				1945/46	52	26	5				
1914/15	17	6						1946/47	28	12					
1915/16	73	57	35	27	8			1947/48	84	84	76	56	46	31	21
1916/17	50	26	3					1948/49	27	7					
1917/18	50	29						1949/50	27	20					
1918/19	7	3						1950/51	12	9					
1919/20	77	71	56	39	30	14	5	1951/52	41	29	17				
1920/21	19	10	7					1952/53	18	11					
1921/22	27	9	1					1953/54	13	9	3				
1922/23	96	78	50	21	6			1954/55	18	8	1				
1923/24	43	16	3					1955/56	49	29	14	6	1		
1924/25	25	19	1					1956/57	33	25	14				
1925/26	38	26	22	9	3										
1926/27	57	32	6					means	36.6	22.8	9.0	3.4	1.7	0.7	0.4

the prolonged snowcover or vice versa is a subject for controversy and quite likely varies from one year to the next.

Snowcover Seasons

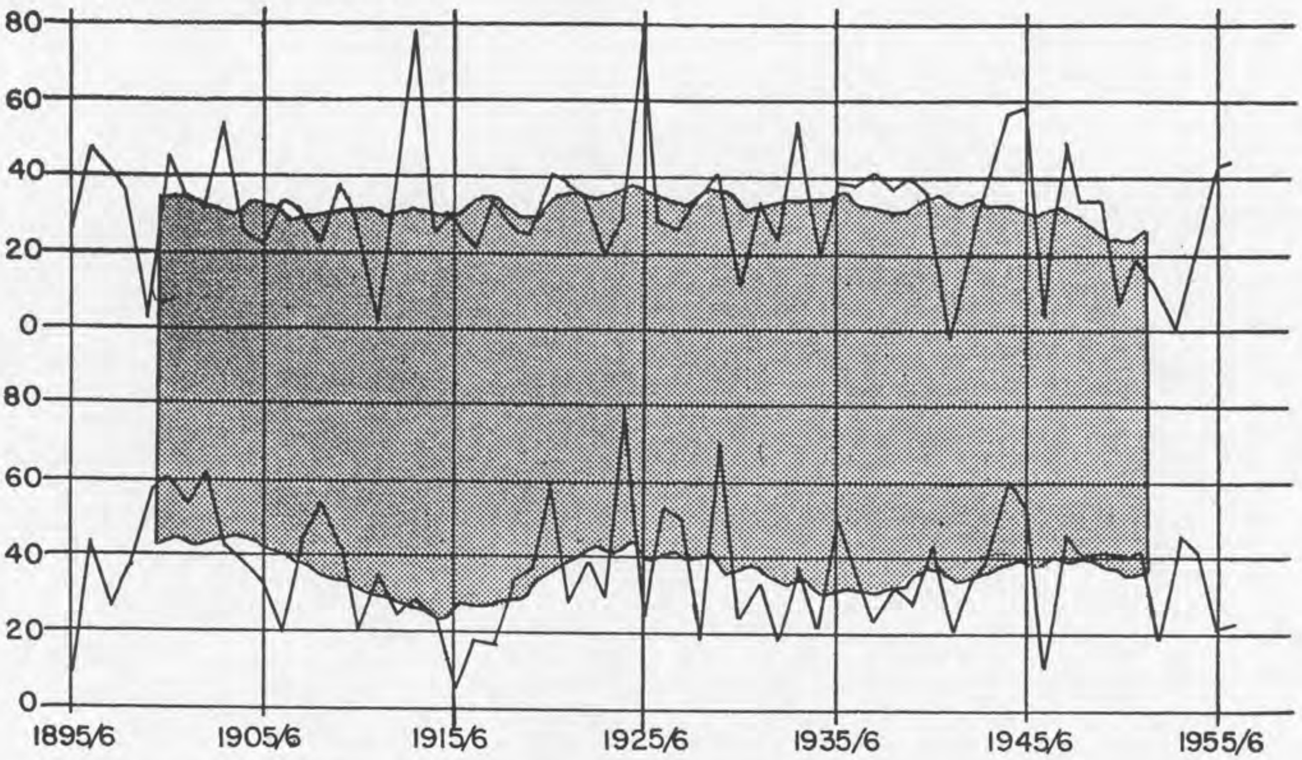

Fig. 6 Upper trace: Days before January 1 with first snowcover equal to or greater than 0.3 inch. Lower trace: Days before May 1 with last snowcover equal to or greater than 0.3 inch. Shaded portion: Ten-year moving means of relative lengths of seasons with snowcover equal to or greater than 0.3 inch.

Figure 6 gives the first and last dates with snowcover equal to or greater than 0.3 inch, 10-year moving means of the first and last dates, and the shaded part gives the relative lengths of snowcover seasons. Of particular interest in Figure 6 is the 10-year moving mean number of days before January 1. Though the first snowcover of 0.3 inch has occurred as early as October 10 and as late as January 4*, the 10-year mean line shows very little fluctuation and no real trends. The last snowcover has been as early as February 10 and has remained until April 28. However, the 10-year line of the mean date of the last snowcover shows a very definite variation. Comparison with other figures shows some possible correlations. It is closely related to the seasonal days with snowfall. Why this should have a bearing on the last day with snowcover and not the first is difficult to explain. The only apparent solution is that more snow falls in the periods of greater snowfall days and therefore would necessarily remain on the ground longer unless unusually warm temperatures prevailed.

*This season's first snowfall and snowcover equal to or greater than 0.3 inch came January 7, the latest of any season on record.

It was pointed out earlier, however, that with warmer temperatures, the number of snowcover days is reduced. Thus, the temperature variable is introduced as having an effect on the snowcover days.

Comparison with the values in Table II, the 10-year moving means of December, January, and February mean temperatures, shows as much discrepancy as correlation. The late winter mean temperatures must, therefore, have a more pronounced effect on the lateness of the snowcover season. A simple statistical comparison bears this out very well.

It was suggested above that with normal temperatures and greater than normal number of days with snowfall the resulting above normal snowfall would probably mean a longer snowcover season.

A third factor is the number of snowfalls of 12 inches and more (Fig. 3). The trends of large storm frequency and last snowcover dates are very similar and suggest the most probable reason for the variation in these dates. It is conceivable that when a season has one or two major snow storms, the snow is much less likely to melt completely off without being replenished from time to time by other lesser snow storms. This replenishment and subsequent maintenance of a snowcover is reflected very well in Figure 6.

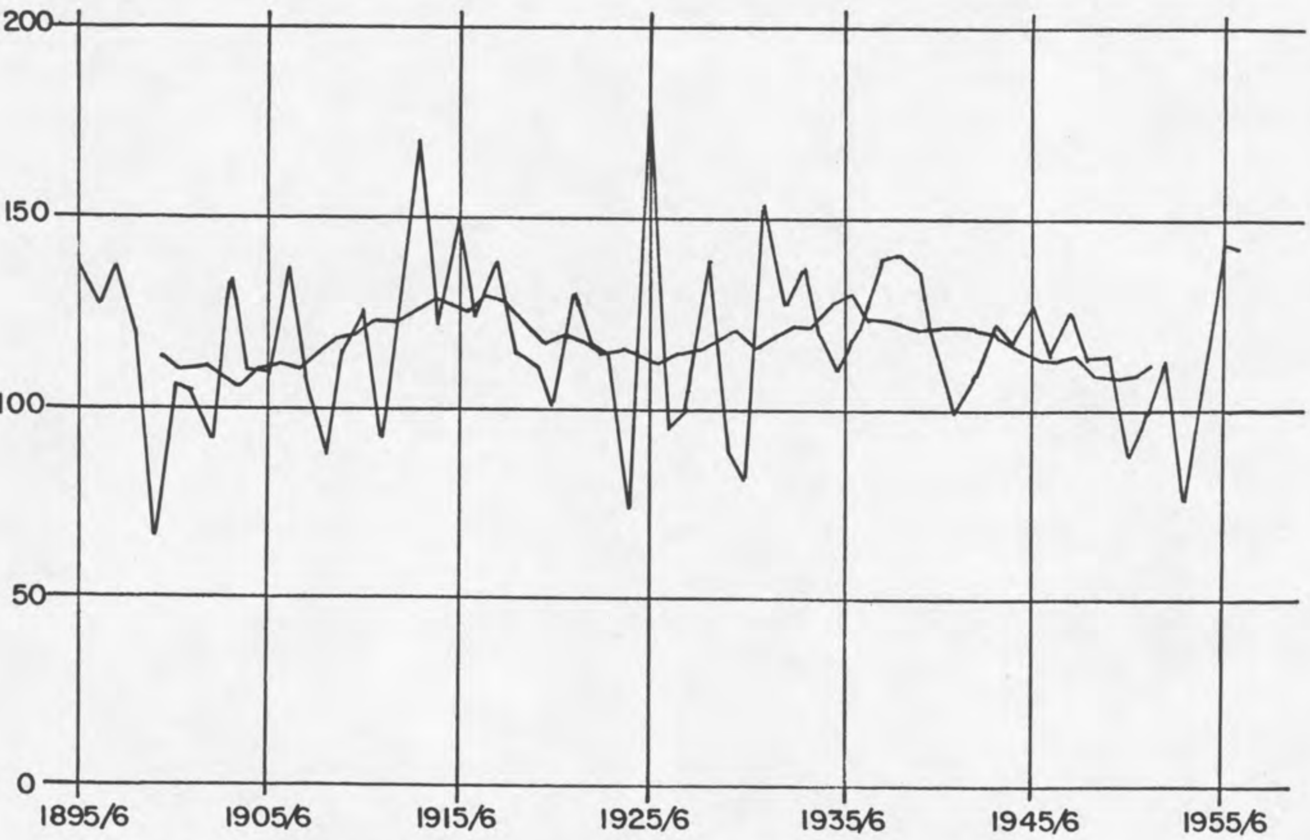

Fig. 7 Annual and ten-year moving mean lengths of seasons with snowcover equal to or greater than 0.3 inch.

Figure 7 depicts the annual lengths of the snowcover seasons and the 10-year moving means of these values. A comparison of the two figures will demonstrate that the 10-year moving mean length of snowcover season is influenced almost entirely by the lower trace in Figure 6. Therefore, the conclusions drawn for that trace are applicable to the significance of the curve in Figure 7.

Winter Severity

What happened to the "good old winters"? J. H. Conover, of the Blue Hill Observatory, wrote a very interesting paper which was published in "Weatherwise" seven years ago. He devised a winter severity index and used it as a means of comparing winters with respect to temperature and snowcover. Although he discussed other variables which might be used as indices, he omitted them from the final index and used the number of weeks per season with maxima no higher than 32° and added this to the number of weeks per season (each multiplied by seven to obtain a total in terms of days) with average snow depths of 6 inches or more. The temperature factor normally has about twice the weight of the snowcover factor.

This author, in employing the index, used the actual number of days with snowcover of 6 inches or more rather than the number of weeks which averaged 6 inches. This was done because it was felt that some of the bigger snow storms occurring late in the season do not result in a lasting snowcover as do earlier storms. Thus, while a storm might deposit as much as 10 inches of snow, it is conceivable that the warmer temperatures of the late season would rapidly melt it away. The average for the week would be apt to be less than 6 inches and would not, therefore, be added to Conover's index. Nevertheless, this storm would leave quite an impression on those who were inconvenienced by the snow and would be remembered as much as, or perhaps more than, a 10-inch storm which had occurred during the earlier part of the winter when such things are expected. In their minds, this would be instantly thought of as a severe winter.

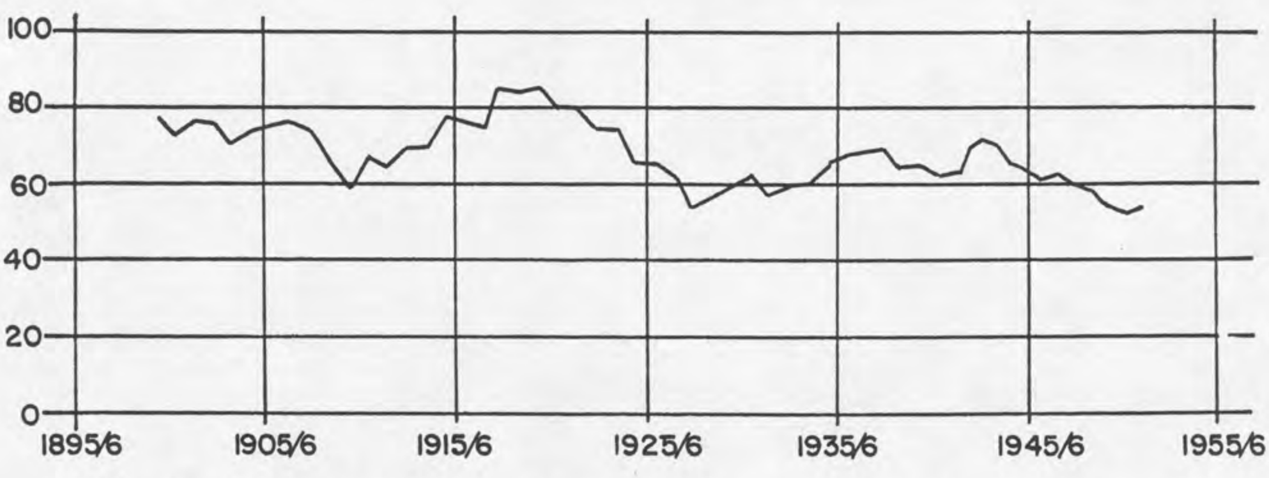

Fig. 8 Ten-year moving means of winter severity indices (after Conover).

While this re-evaluation of the index did not alter the 10-year moving means appreciably, some annual indices were changed by more than 15. The winter of 1922/23 still rates as the most severe with an index of 146. This is 6 units less than Conover rated it. In support of the theory presented above, it is interesting to note that nearly 70 percent of the total snow fell before February 1 of that season. The winters of 1919/20 and 1947/48 rank second with a rating of 144. Conover had rated them 143 and 130 respectively. The infamous 1917/18 winter is rated 96 compared to Conover's 74. The large difference is reflected by the occurrence of snow late in the winter. Forty percent of the season's snow fell after March 1. The mildest winter was 1936/37 which is rated 27. Two more recent winters, 1950/51 and 1952/53, follow closely with respective ratings of 29 and 28.

The 10-year moving means of the winter severity indices reflect a general downward trend over the period of record. The decades ending in the early 1920's had the highest ratings while the most recent decades have had the lowest indices. The decade ending 1955/56 was rated the mildest on record. Any index below 127 this season will establish a new low rating and continue the overall decline.

Mid-Winter Dates

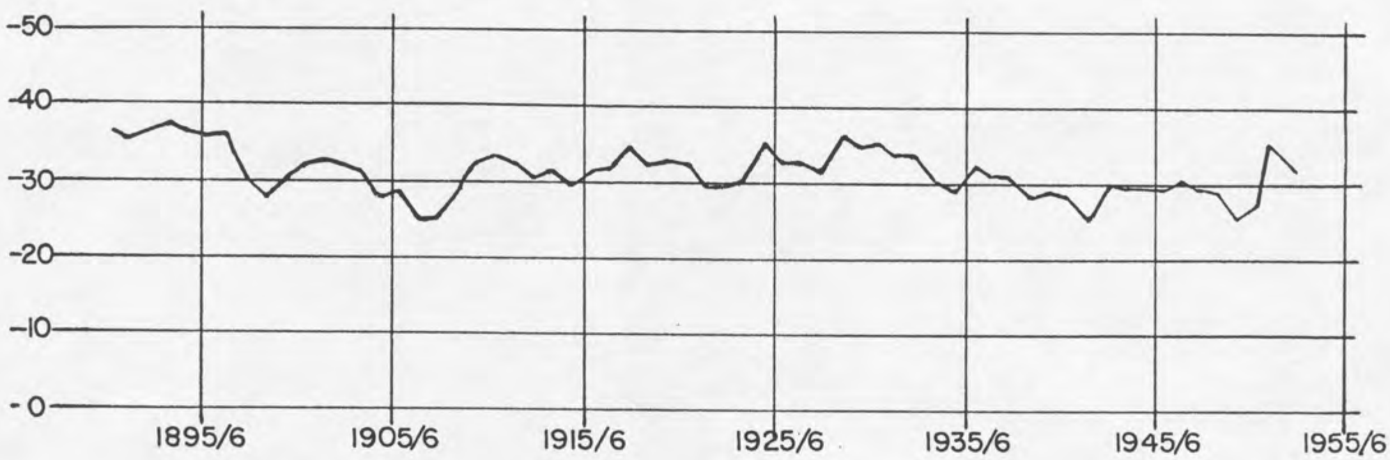

Fig. 9. Ten-year moving means of dates when one-half of seasons' total snow had fallen.

The mid-winter date refers to the date when one-half of a winter's snow has fallen. The mean for the period of record occurs between January 31 and February 1. Figure 9 shows the 10-year moving means of days after December 31. After the initial decline and subsequent rise to a secondary maximum in the decades ending in the early 1930's, the mid-winter date has been getting progressively earlier. The heavy snows of March and April 1956 were the reason for the latest mid-winter date on record -- March 16. This has also resulted in a recent upturn in the decadal means. The earliest mid-winter date was December 27 and occurred in the winters of 1894/95 and 1902/03. Generally speaking, however, our winters of the past 15-20 years are not beginning and ending later than in the preceding 25.

Summary

The annual snowfall totals have varied between 136.0 and 12.6 inches, the former the winter of 1947/48 and the latter the 1936/37 season. The 10- and 30-year moving means have indicated a trend of less snowy winters until the late 1920's and early 1930's. Since that time, a decadal mean increase in snowfall has been followed by a period of snowy winters which show no definite trend toward either more or less snowy ones. The past 36 years have averaged 2.5 inches per season less snow than the first 36.

Since the decade ending 1922/23, the mean seasonal days with snowcover equal to or greater than T has shown a nearly continuous downward trend. The tendency for the mean December, January, and February temperatures since 1922/23 has been to increase. Thus, an instantaneous relationship is assumed. In that specific decadal mean temperatures are not always reflected in the number of snowcover days, other factors must be influential. Among these are the effects of soot, variation in insolation received, and wind. It appears that the proximity of the mean winter (December, January, and February) temperatures to 32° has the most influence on the number of light snowcover days. In that the mean winter temperatures since 1947/48, with one exception, have averaged at least 28.0° and the 10-year moving mean temperatures are at their highest average on record, the reason for the continued decrease in days with snowcover equal to or greater than T is more apparent. This factor with those mentioned above, should serve at least as a partial explanation. The last half of the record has averaged 14 fewer days with snowcover equal to or greater than T than the first half.

The length of the snowcover season apparently varies more consistently with the last date with a snowcover rather than the first. There are at least three possible explanations for this. The mean temperature for the late winter months must have a pronounced effect if temperature is to be considered as a factor. The December, January, and February mean temperatures show very little comparison with the late season snowcovers. Secondly, when there are below normal temperatures, the number of snowfall days rises and the snowfall amounts are generally greater. This is apt to result in a longer snowcover season, though other variables can cancel these effects out. Thirdly, the trends of large storm frequency and last snowcover dates are very similar and suggest that the prevalance of major storms and their subsequent replenishment by lesser storms before completely melting could result in a longer snowcover season.

It was found by using a winter severity index devised by J. H. Conover with a slight adjustment that tends to weight the large but more rapidly melted late season storms that the winters have not been as severe over the past 25 years from the standpoint of low temperatures and notable snowcover. The 10-year moving means showed a record low index rating for the decade ending 1955/56.

Winters are not beginning later and ending later as many people think. In fact, in the past 25 years the opposite has been true. This is with the exception of the winter of 1955/56 when the late season heavy snows buried the Northeast.

Acknowledgments

The author would like to give humble thanks to the memory of the late Dr. Charles Franklin Brooks. The author received from him his start in climatology and his interest in it was maintained through the fatherly guidance and personal friendliness of Dr. Brooks. A month before his death he gave me my greatest honor -- that of co-authoring this paper with him. It was in his memory that the author chose to continue this work.

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