Note in the New Haven and Detroit records how the striking crests *a b* in the third period still persist in the 45-year means.

It is proper to consider at this point what would have been the outcome of this investigation if it had been feasible to use, say, 72 or 24, instead of 52 week like subunits of the cycle. It seems easy to imagine that the number and distribution of the conspicious features would be quite different. In other words, the detailed features would depend upon the method of analysis and not have a real existence.

Each striking feature on a long record is, therefore, no evidence of the persistent recurrence of peculiar irregularities, but is simply the residual scar or imprint of some unusual event, or a few which have been fortuitously combined at about the time in question. Time will inevitably efface these, but a very long time is necessary to reduce the curve to even the semblance of smoothness and simplicity. Little is gained by combining the results from many stations unless widely separated or for different periods, because all are likely to be similarly impressed by the same major irregularities. If widely separated, the averages may be smoother, but individual characteristics peculiar to a locality are very likely to be lost. The composite records Nos. 9, 10, and 11, are examples of this treatment.

Referring to the final conclusions stated in the synopsis, it is believed the foregoing studies clear away grave uncertainties and conflicting opinions concerning the annual cycle of temperature and we are now in a position to produce daily, weekly, or other normal values of any kind desired. These are much needed for the purpose of carrying out interesting and important studies which are in contemplation of the frequency distribution and standard deviations of temperature data, including more serious investigations of the cause and effect relations between terrestrial temperatures and cosmic and other influences.

LITERATURE CONCERNING SUPPOSED RECURRENT IRREGULARITIES IN THE ANNUAL MARCH OF TEMPERATURE.

By C. Fitzhugh Talman.

[Dated: Weather Bureau Library, Washington, May, 1919.]

The belief that periods of unseasonable heat and cold tend to recur at or about the same time from year to year has prevailed over a great part of the world for many centuries and has been the subject of extensive scientific investigation. Among the most widely recognized periods of this character are the following:

1. *A mild period in January, the "January thaw."*—This period is popularly looked for in America, especially in New England, but apparently not in Europe.[1]

2. *A cold period in April.*—This is the "blackthorn winter" of England, so called because it is supposed to set in when the blackthorn is in blossom.[2] In this connection it may be noted that in various parts of the United States so-called "winters" are popularly associated with the flowering of the redbud, dogwood, snowball, and other plants. R. Abercromby,[3] who found evidence of a recurrent cold period in Scotland, April 11–14, shows that, taking account of the change from the Julian to the Gregorian calendar, this period coincides with the "borrowing days," the last three days of March, reputed in British folklore to have been borrowed by March from April, and notorious for cold and stormy weather.

3. *A cold period in May.*—In European weather lore this is the most celebrated of the periods under discussion. Over a considerable part of continental Europe it has been popularly believed since the Middle Ages that destructive frosts were likely to occur at a certain period in the month of May, and with the elaboration of the ecclesiastical calendar these frosts became definitely associated with the days dedicated to Saints Mamertus, Pancras, and Servatius (May 11, 12, 13), or, in south-central Europe, Saints Pancras, Servatius, and Boniface (May 12, 13, 14), hence known as the "ice saints." These saints and their days are called in French *saints de glace;* in German, *Eisheiligen*, *Eismänner*, or *gestrenge Herren.* In Bohemia, Pancras, Servatius, and Boniface are known collectively as Pan Serboni.

Passing mention should be made of the fact that in France the full moon which occurs late in April or early in May has a bad reputation as a bringer of frosts. It is known as the *lune rousse* ("russet moon"), in allusion to the brown appearance of frosted vegetation. Both the ice saints and the *lune rousse* evidently owe their notoriety to the fact that the beginning or early part of May is a critical period in the growth of vegetation, and frosts occurring at this time attract more attention than those which occur at other seasons.[4]

4. *A cold period in June.*—This depression in temperature is generally much more pronounced in European meteorological records than the cold period in May, but has not attracted public notice to the same extent because it is generally harmless to vegetation. It is recognized in German weather lore as the *Schafkälte* ("sheep-cold"); i. e., a chilly period dangerous to newly shorn sheep.[5]

5. The *dog days* (a period of heat after midsummer) doubtfully belong in this list. Various notions prevail as to their duration and time of occurrence, but in general they may be regarded as coinciding with the crest of the annual temperature curve, rather than with any irregularity therein.[6]

6. *Squaw winter.*—In the northern United States and Canada a period of wintry weather is reputed to precede Indian summer, and is known as "squaw winter."[7]

7. *A mild period in autumn*, especially in October and November; Indian summer of North America; St. Martin's summer, after-summer, old wives' summer, etc., of Europe. Typical Indian summer weather is calm, dry, and hazy or smoky, as well as warm for the season. The corresponding period in the Old World is associated in

[1] Messrs. W. M. Esten and C. J. Mason, in a discussion of a 21-year temperature record made at Storrs, Conn., find a sharp and prominent rise in the curves of both mean and extreme temperatures between the 20th and the 25th of January, which they identify with the "January thaw" of popular weather lore. (Storrs Agr. Exper. Sta. Bull. 64, September, 1910, p. 179.) There is, however, a surprising paucity of literature on this subject.

[2] J. Wright, "English dialect dictionary," 1, p. 284.

[3] Jour. Scott. meteor. soc., 2, 1867, p. 284.

[4] Moonlight at this period is correctly associated in the popular mind with frost, because a moonlit night is also a clear night, and hence favorable for nocturnal radiation. (See A. Angot, "Traité de météorologie," 3d ed., p. 398.) There is an abundance of other literature on the subject of the *lune rousse*.

[5] K. Almstedt, "Die Kälterückfälle in Mai und Juni," 1913, p. 5.

[6] As to the dates of the dog days, see the Oxford "New English Dictionary," s. v. *dog days*.

[7] The same name is occasionally applied to a spell of unseasonably cold or snowy weather in spring, *vide* Jour. Amer. Folk-lore, 20, 1907, p. 235.

popular lore with the presence of floating spider webs (gossamer) in the air. The American Indian summer is extremely irregular in its time of occurrence;[8] so irregular as to point clearly to the fact that it is rather a *type* of weather, prevailing intermittently in the autumn, than a single recurrent irregularity in the autumnal temperature curve. The European "after-summer" has been assigned more definitely to certain dates, owing in part to its association with the names of particular saints. These dates vary widely, however, from place to place. According to A. Lehmann,[9] they range from August 15 (Julian calendar), the beginning of the "young women's summer" of Russia, to November 11, St. Martin's day, a date popularly associated with the after-summer in Germany, Holland, France, Italy, and sometimes England. Broadly speaking, two after-summer periods are recognized in Europe, one prevailing approximately from September 22 to October 9, and the other early in November.

The tendency of particular types of weather to occur at about the same period from year to year has been described by R. Abercromby[10] under the generic name of "recurrence." The phenomena classified under this head are not all peculiarties of temperature. For example, in England a rainy period, known as the "Lammas floods," is looked for about August 2–8. On both sides of the Atlantic "equinoctial storms" are expected about the time of the equinoxes, especially the autumnal equinox. In the present paper, however, we are concerned only with recurrence as a phenomenon of temperature.

Departures from a smooth annual curve of temperature have been described by Buchan and others as "interruptions of temperature." German terminology further specifies a downward inflection of the curve during the half of the year in which the temperature is generally rising as a *Kälterückfall* ("return of cold"), and an upward inflection during the other half of the year as a *Wärmerückfall* ("return of heat").[11] The irregularities in question are frequently referred to as "anomalies"; an expression justifiable on etymological grounds (ἀνωμαλία= unevenness, irregularity), but perhaps somewhat unfortunate because tending to suggest the idea of "abnormality." If we characterize these irregularities as "abnormal" we beg the question as to what constitutes a normal progression of temperature, and this is the very question we are trying to settle in our study of the alleged recurrent interruptions. A further objection to the use of the word "anomaly" in this connection is that the expression "thermal anomaly" has been used since the time of Dove in a special sense quite remote from the one under consideration.

The following bibliography, while not exhaustive, includes all the more important publications relating to the subject in hand, and also many contributions of minor importance which serve to illustrate the general character of the literature on this subject.

It will be observed that much the largest number of publications relate to the cold period supposed to recur in May and assigned by popular tradition to the days of the "ice saints." The first somewhat comprehensive study of this phenomenon from a scientific standpoint was made in 1834 by the astronomer J. H. Mädler, who suggested that the temperature depression experienced in Germany was due to the cooling of the air to the northeastward, where, he assumed, a large amount of heat was abstracted from the atmosphere every spring in the melting of ice over the great basin of the River Dvina. The idea that the rise of temperature in spring may be checked over extensive areas on account of solar heat becoming latent in the process of melting the ice and snow of high latitudes, or of the Alpine summits, recurs in subsequent literature.

In 1839 Adolf Erman advanced the hypothesis that the cold period in May and one in February were due to the passage of periodic meteor showers between the earth and the sun. According to this hypothesis the meteors which are visible at opposition as the well-known showers of November and August are in inferior conjunction with the sun six months later, viz, in May and February, respectively, and then cut off a certain amount of solar heat from the earth. This hypothesis was later expanded by F. Petit (1863), who sought to explain various recurrent periods of warmth, as well as cold, as due to the effect of meteors in enhancing or diminishing the insolation received by the earth. A kindred idea was that of Sainte-Claire-Deville, who, in a long series of papers in the Comptes Rendus (1865–1876), described recurrent perturbations or brusque oscillations of temperature supposed to occur at intervals through each year and suggested that these might be due to the passage of the earth through masses of cometary matter in space.

An elaborate study of the cold period in May was published in 1856 by H. W. Dove, the foremost meteorologist of his time. Dove examined the means of temperature for pentads (five-day periods) for various stations through the year and found that the third pentad of May was, on an average, colder than the second in western Russia (Courland), Germany, Belgium, France, and southern England. He recognized that this cold period was due to northerly winds, but his attempt to explain the prevalence of such winds was in conformity with his well-known hypothesis of conflicting "equatorial" and "polar" currents, which antedated correct knowledge concerning cyclones and their attendant phenomena. Dove pointed out that the winters were commonly longer and more severe in North America than in western Europe, and he believed that in the spring a strong "polar" air current, coming as a northwest wind from America, interrupted the normal flow of the mild southwest "equatorial" current then prevalent over Europe.

With the construction of synoptic weather charts, the barometric conditions that accompany depressions of temperature gradually became apparent. The cold period of May was discussed from this point of view as early as 1877 by Billwiller, and more fully by Klein (1881), Assmann (1881), Bezold (1883), and others. It was found to occur when, owing to the rapid warming of inland regions as compared with the ocean, a center of low barometric pressure develops over southeastern Europe, while high pressure prevails over the ocean to the northwest, a situation that gives rise to cold northerly and northeasterly winds in central Europe. The barometric situation attending the more pronounced fall in temperature that often occurs in June has also been studied, and this is found to coincide with the setting in of the summer rainy season over central Europe. Similar studies have been made in regard to other irregularities in the annual temperature curve, including unseasonably mild periods in autumn (Indian summer, etc.).

While the immediate causes of these interruptions of temperature have thus been made clear, it is not yet certain whether or to what extent such interruptions, with

[8] *See* MONTHLY WEATHER REVIEW, Wash., 30, 1902, p. 27, footnote 63, and p. 440–442.

[9] "Altweibersommer," p. 61.

[10] "Principles of forecasting," 2d ed., Lond., 1885, p. 65.

[11] No English equivalents of these expressions have become established in the vocabulary. V. H. Ryd ("On computation of meteorological observations") translates *Kälterückfall* "cold-relapse." The supposed recurrent depression of temperature in the second decade of May has been called the "May dip." (Monthly Weather Rev., 30, 1902, p. 442.)

their attendant barometic conditions, tend to recur from year to year on certain dates, such as the days of the ice saints. Irregularities in a curve showing the mean annual march of temperature as deduced from a record of fifty or a hundred years may be due to excessive departures in particular years rather than to a real tendency to recurrence on particular dates, and, on the other hand, a tendency to recurrence might not manifest itself in the mean curve, especially if, as some students have surmised, the phenomenon is one that undergoes periodic fluctuations.

A method of testing long temperature records for the existence of recurrent interruptions, which has been applied by Vincent (1882), Kremser (1900), Barnard (1900), Luizet (1907), and notably by Roche (1881), in his comparison of records made in the eighteenth and the nineteenth centuries at Montpellier, is to divide the total record into two or more parts and compare the curves based upon the partial records. This process has yielded conflicting results, as will appear from the notes in the bibliography.

Most of the literature cited below antedates the study of "centers of action." As pointed out by Arctowski, in his memoir of 1917, future investigations of the subject under discussion must take account of these important features of the general circulation. It will also be necessary to investigate the bearing of aerological data upon the subject; this has hardly yet been done except as noted under the citation of Hergesell's paper of 1900.

Lastly, it will be noted that many writers still, as in earlier times, look to cosmical causes to explain the alleged phenomena in question.

1820.

Brandes, H. W.

Beiträge zur Witterungskunde: Untersuchungen über den mittleren Gang der Wärme-Aenderungen durchs ganze Jahr. . . Leipzig, 1820.

The author discusses the annual temperature curves of 12 European stations, as deduced from pentad (five-day) means, and points out several irregularities that seem to be more or less general. A cold period in late February or the beginning of March is attributed to the fact that the sun is then rising above the Arctic shores of Europe and Asia. As the coldest time of the day in middle latitudes is shortly before sunrise, the regions in question should, the author thinks, be then having their minimum temperature. The thermal contrast between the arctic regions and lower latitudes results in northerly winds, and cold weather is thus propagated southward.

1830.

Z.

On the cause of the peculiar aspect of the air, in the Indian summer. American journal of science and arts, New Haven, **18**, 1830, p. 66-67.

Deals with optical features only.

1834.

Mädler, J. H.

Ueber die Temperatur der zweiten Maiwoche zu Berlin. Verhandlungen des Vereins zur Beförderung des Gartenbaues in den K. Preussischen Staaten, Berlin, **10**, 1834, p. 377-384.

The author, from an examination of an 86-year temperature record at Berlin, finds evidence of a recurrent cold period May 10-13, and attributes it to the melting of ice in the River Dvina.

1835.

Essay on the Indian summer, read at a meeting of the Maryland academy of sciences, by one of its members, Baltimore, Dec. 16, 1833. American journal of science and arts, New Haven, **27**, 1835, p. 140-147.

"The increased temperature which accompanies the existence of this hazy weather is referable to several causes, viz:

"1st. The prevailing wind, which, being from a southerly direction, is usually warm.

"2d. The heat radiated from the earth's surface is immediately returned (on a well-known principle), being reflected back by the haze of the atmosphere, while lastly the temperature is further increased by the condensation of both air and moisture during the formation of the foggy stratum."—p. 147.

1836.

Foot, Lyman.

Remarks on Indian summers. American journal of science and arts, New Haven, **30**, 1836, p. 8-13.

"As to the *increased* temperature, during Indian summer, we can not agree to it. From the document we have quoted (Meteorological register), it appears that the mean temperature for November is somewhat lower than that of October. It is from the quiet, placid state of the atmosphere that some are led to suppose it is actually warmer. But he who keeps an accurate record of the thermometer will find it is a mistake."—p. 12.

1838.

Mahlmann, C. H. W.

Der Indianer Sommer in Nord-Amerika, verglichen mit gewissen Witterungserscheinungen Mittel-Europas. Annalen der Physik und Chemie, Leipzig, **44**, 1838, p. 176-189.

Points out possible influences of dry fog (smoke from forest fires, etc.,) on temperature, as a cause of Indian summer.

1839.

Erman, A.

Ueber einige Thatsachen, welche wahrscheinlich machen, dass die Asteroïden der Augustperiode sich im Februar, und die der Novemberperiode im Mai eines jeden Jahres zwischen der Sonne und der Erde, auf dem Radius Vector der letzteren, befinden. Annalen der Physik und Chemie, Leipzig, **48**, 1839, p. 582-601. Also published in Astronomische Nachrichten, Altona, **16**, 1839, col. 363-366.

Advances the hypothesis that the August and November meteor showers pass between the earth and the sun in February and May, respectively, thus cutting off a certain amount of solar radiation from the earth and producing cold periods in the latter months. This hypothesis, especially as bearing on the cold period in May, attracted wide scientific and popular interest and is discussed by many subsequent writers.

1840.

Erman, A.

Sur les étoiles filantes périodiques des mois d'août et de novembre. Comptes rendus de l'Académie des sciences, Paris, **10**, 1840, p. 21-32. Also published in Annales de chimie, Paris, **73**, 1840, p. 315-333.

Sets forth same hypothesis as his paper of 1839, cited above.

1843.

Mädler, J. H.

Über den Gang der Temperatur im Laufe des Jahres. Jahrbuch für 1843, von H. C. Schumacher, Stuttgart & Tübingen, 1843, p. 70-122. (2d pagination.)

Discussion of Berlin temperature record (110 years). The author finds recurrent irregularities as follows:

A warm period, January 9-19; a cool period, May 9-12; an abnormal rise of temperature, May 31-June 3, followed by a fall, June 3-5, and retardation of the normal rise until the 11th; a cool period June 16-22; a sudden fall September 25-30. He agrees with Brandes in ascribing the cold period in January, and one found by Brandes at various stations in February, to the propagation of cold weather from the Arctic coasts of Europe, where the sun is then rising. As to the cold period in May, he raises objections to Erman's meteorite hypothesis, and reaffirms his belief in the explanation given in his own earlier memoir (melting of ice in northern rivers).

1844.

Jacobs, M.

Indian summer. Literary record and journal of the Linnaean association of Pennsylvania college, Gettysburg, **1**, 1844-45, p. 84-88; 105-108; 135-139.

Describes Indian summer as one of four recurrent periods in the year characterized by quiet weather, with a smoky or hazy atmosphere, and explains as a period of atmospheric equilibrium, between the seasons in which land and sea breezes, respectively, prevail.

1847.

Buys-Ballot, C. H. D.

Les changements périodiques de la température, dépendants de la nature du soleil et de la lune, mis en rapport avec le pronostic du temps, déduits d'observations néerlandaises de 1729 à 1846. Utrecht, 1847.

Includes a brief discussion of Erman's hypothesis as to effects of meteor showers in causing temperature depressions.

1849.

Azéma, E.

Sur les froids observés dans le mois de mai. Annales de la Société d'agriculture, sciences, arts et commerce du Puy, Le Puy, **14**, 1° sem., 1849, p. 287-291.

Abstract of memoir by Fournet.

Crahay, J. G.

Sur la période de froid vers le milieu du mois de mai. Bulletins de l'Académie royale de Belgique, Bruxelles, **16**, 1re partie, 1849, p. 466–472.

Observations at Maestricht, 1818–1834, and Louvain, 1835–1848, show a depression of the average temperature, with northerly winds, about the middle of May.

Fournet, J.

Note sur le froid périodique du mois de mai. Annales de la Société royale d'agriculture, Lyon, (2) **1**, 1849, p. 1-31.

Original not seen, but this appears to be the memoir abstracted at some length by Azéma, as cited above, in which Fournet attributes the recurrent cold period in May to the melting and breaking up of ice in the polar regions, and also in the rivers of Europe. According to a reference in Becquerel, "Des climats," p. 46, Fournet states that the cold period in May is observed on the coasts of America.

1851.

Barral, J. A.

Sur le froid périodique du mois de mai. Journal d'agriculture pratique, Paris, (3) **2**, 1851, p. 363–364.

Records an anecdote of Frederick the Great and the three ice saints. Presents the views of Mädler, Fournet, etc.

1853.

Sabine, Edward.

On the periodic and nonperiodic variations of the temperature at Toronto in Canada, from 1841 to 1852, inclusive. Philosophical transactions of the Royal society, London, **143**, pt. 1, 1853, p. 141–164.

Presents five-day means of temperature through the year, for Toronto, based on a 12-year record, and mentions the pentad values that "indicate in some degree a tendency to periodical recurrence." The temperature depression of May 11–13 (ice-saints) found by Mädler for Berlin is not found in the Toronto record.

1854.

Quetelet, L. A. J.

Mémoire sur les variations périodiques et non périodiques de la température, d'après les observations faites, pendant vingt ans, à l'Observatoire royal de Bruxelles. Mémoires de l'Académie royale de Belgique, Bruxelles, **28**, 1854.

Includes a conservative discussion of alleged recurrent periods of heat and cold, and gives a list of the irregularities found in the temperature curve for Brussels for the years 1833–1852.

1857.

Dove, H. W.

Über die Rückfälle der Kälte im Mai. Abhandlungen der K. Akademie der Wissenschaften, aus dem Jahre 1856, Berlin, 1857, p. 121–192.

This classic memoir on the cold period in May has been quoted by nearly all subsequent writers on the subject, and its conclusions were, for a long time, generally accepted without question. From an elaborate discussion of the records of more than 40 stations in Europe the author finds that a recurrent fall in temperature between May 8 and 13 manifests itself from Courland westward over Germany, Belgium, France, and southern England, and is espeically characteristic of central Germany. As in other well-known papers by Dove, pentad means of temperature are used in his discussion. His method is thus described by V. H. Ryd (op. cit. infra):

"Since Dove had at his disposal only a few series of observations which were sufficiently long for him to be able to use the means for the separate days, he used, to a great extent, five-day groups for his investigations. For the month of May in each separate year he has calculated the mean for the five-day period from the 1st to the 5th and from the 6th to the 10th, etc. Thus he has established normal places the 3d, 8th, 13th, 18th, 23d, and 28th of May. Let us call these values o_3, o_8, ... o_{28}. Dove then forms the differences o_8-o_3, $o_{13}-o_8$, $o_{18}-o_{13}$, etc., and when these differences get negative values, it is noted as a 'relapse.' If the true temperature curve is smooth, there will, with respect to May, where the temperature is chiefly rising, be greater probability that these differences become positive than that they become negative. Since the investigation concerns the days 11th, 12th, and 13th May, it is the differences $o_{13}-o_8$ which it depends upon, and when, f. i., Dove finds that these differences, with respect to Breslau, become negative 30 times in 66 years, this is taken as a *proof* of the existence of 'cold relapses'."

In his attempt to explain this alleged recurrence, Dove invokes his familiar hypothesis of conflicting "equatorial" and "polar" winds. His explanation, now only of historic interest, follows:

"Bestimmt man in Europa und in Nordamerika die mittlere Windesrichtung für die einzelnen Monate, so findet man, dass sie in Europa in den Wintermonaten auf die Sü dwestseite, in den Sommermonaten auf die Nordwestseite fällt. In Amerika findet das Entgegengesetzte statt; hier ist in den Sommermonaten die Windesrichtung mehr südwestlich, in den Wintermonaten mehr nordwestlich. Die Frühlingsmonate stellen den Wendepunkt dar; hier wird in Europa die südwestliche Windesrichtung durch eine nordwestliche verdrängt, dort die nordwestliche durch eine südwestliche. Die Polarströme, welche also im Winter vorwaltend über Amerika den Äquator zuströmen, wählen vom Frühling an ein anderes Bett über Europa hin. Dadurch erklärt sich die Häufigkeit des Einbrechens neuer Kälte in Europa durch dieselbe Ursache, wie das seltenere Hervortreten von Einbiegungen in Amerika. Die kalten Maitage bilden also ein Glied in der Kette jener grossen periodischen Veränderungen, welche sich in der Wanderung der Isothermen und in der Auflockerung der Luft im Sommer von Asien so überwiegend aussprechen. Vielleicht ist der Indianer-Sommer Amerika's das den gestrengen Herren entsprechende, in einer andern Form auftretende Phänomen des Herbstes in der neuen Welt."

Fournet, J.

Première note sur la pronostication. Annales des sciences physiques et naturelles, d'agriculture et d'industrie, Lyon, (3), **1**, 1857, p. 172–179.

Forms part of "Rapport . . . de la Commission des soies . . . 1856." The author calls attention to the general parallelism between mean annual temperature curves for three stations in different climatic regions of France; viz, Paris, Marseille, and St. Jean-de-Maurienne, and gives a list of the principal depressions. States that the period of the ice saints occurs in France about May 17–22, and that at Paris there were only two years between 1840 and 1856 in which this cold period did not prevail.

Plantamour, E.

De la température à Genève d'après vingt années d'observations (1836 à 1855). Mémoires de la Société de physique et d'histoire naturelle, Genève, **14**, 1857, p. 289–330.

Points out clearly the fallacies involved in the hypothesis that recurrent irregularities in temperature are due to the passage of meteors. Describes the winds and other meteorological conditions associated with cold periods in spring and a warm period in the mean temperature for November, but does not deal directly with the problem of recurrence on particular dates.

Sachse, K. T.

Pankratius und Servatius, ein Beitrag zur Witterungsgeschichte Dresdens. Dresdener Journal, 1857.

Not consulted.

1860.

Dove, H. W.

Über die kalten Tage im diesjährigen Mai. Monatsberichte der K. Preuss. Akademie der Wissenschaften, aus dem Jahre 1859, Berlin, 1860, p. 426–431.

Note on striking depression of temperature in May, 1859, following a mild winter. Dates of occurrence (May 11–16) given for different parts of Europe. These depressions are attributed to the wind system resulting from the contrast of temperature between the snow-covered regions of the North and the warmer regions of the South, according to the author's theory of conflicting polar and equatorial currents.

1863.

Bloxam, J. C.

On the winter which occurs in the spring of the year and on the summer which occurs in the fall of the year. Proceedings of the British meteorological society, London, **1**, 1863, p. 321–329.

"On the 21st of April the humidity is at its minimum value for the year, viz, 71.7. This is the essential fact which solves the problem: The 21st of April differs from every other day in the year in this respect; and the blackthorn winter reaches its culminating point on this day. The evaporation produced by this low degree of humidity gives rise to that peculiar feeling of cold which characterizes the season."—p. 324.

"The 9th of November may be regarded as the day on which the equinoctial summer, or St. Martin's summer, culminates, because the humidity attains a high and a maximum value on that day. Excessive humidity and consequent defective evaporation are the cause of the sensible warmth which attracts attention."—p. 327.

Fitz Roy, Robert.

The weather book: A manual of practical meteorology. London, 1863.

Cold periods in spring attributed to the fact that much atmospheric heat is used in melting the ice of circumpolar latitudes. Conversely, the liberation of latent heat in autumn, during the formation of ice in circumpolar latitudes, produces the mild weather of Indian summer.—p. 76 & 166–167.

Fonvielle, Wilfrid de.

Le petit hiver et le petit été. Presse scientifique, Paris, **2**, 1862, p. 532–537.

Not consulted.

Petit, F.

Conséquences qui paraissent devoir résulter de la comparaison des températures observées en divers lieux de la terre. Annales de l'Observatoire. Toulouse, **1**, 1863, p. 232–236.

The author finds corresponding irregularities in the annual temperature curve for Toulouse and Paris (based on five-day means for a long period of years) and attributes them to periodic meteor showers (the hypothesis first suggested by Erman, but applied by Petit to a larger number of supposedly recurrent irregularities, including warm periods and cold periods, six months apart, corresponding to the opposite nodes of the meteoric orbits in question).

1865.

Bassi, G. B.

Straordinarii abbassamenti termometrici posteriori alla metà di giugno, sospetti sulla periodica loro generalità, e congetture sulla loro derivazione. Atti. R. Istituto veneto. Venezia, **11**, 1865, p. 1163–1179.

Author finds a recurrent fall of temperature in the fourth pentad of June at various places in Italy and elsewhere in Europe. Suggests possible connection with sunspots.

Ellner, Benedikt.

Über die Rückschritte der Wärme im Monate Mai. Bamberg, 1865.

Not consulted.

Hennessy, Henry.

On the regression of temperature during the month of May. Report of the **24**th meeting of the British association for the advancement of science; held at Bath in Sept., 1864. London, 1865, p. 17 (2d pagination).

Brief abstract suggesting possible influence of dry winds from Asia and eastern Europe, causing high nocturnal radiation.

Sainte-Claire Deville, C. J.

De l'influence probable des apparitions d'astériödes sur les variations de la température de l'air. (Première note.) Comptes rendus de l'Académie des sciences. Paris, **60**, 1865, p. 577–586.

Influence of the August and November meteors on the temperature curve for Paris seems to be shown by comparing temperatures of years when these meteors were abundant with those of years in which they were scarce.

Sainte-Claire Deville, C. J.

Des perturbations périodiques de la température dans les mois de février, mai, août et novembre. (Deuxième note.) Comptes rendus de l'Académie des sciences. Paris, **60**, 1865, p. 696–710.

Same line of discussion as previous paper, but utilizes records of a number of stations in both hemispheres.

Sainte-Claire Deville, C. J.

Des perturbations périodiques de la température dans les mois de février, mai, août et novembre. (Troisième note.) Comptes rendus de l'Académie des sciences. Paris, **61**, 1865, p. 1–12; 61–65.

Develops the idea put forth in his previous notes that there is a periodic perturbation of temperature in February, May, August, and November, disclosed by comparing different groups of years, but masked in the general curve of a long series of years. This takes the form of a more or less pronounced *oscillation* of temperature rather than a departure in one direction.

Sainte-Claire Deville, C. J.

Des perturbations périodiques de la température dans les mois de février, mai, août et novembre. (Quatrième note.) Comptes rendus de l'Académie des sciences, Paris, **61**, 1865, p. 350–357.

Note on an "oscillation" in temperature and other meteorological elements in August, 1865.

1866.

Jelinek, Carl.

Über die mittlere Temperatur zu Wien, nach 90-jährigen Beobachtungen, und über die Rückfälle der Kälte im Mai. Sitzungsberichte, K. Akademie der Wissenschaften. Wien, **54**, 2 Abt., 1866, p. 671–753.

Elaborate analysis of the Vienna temperature record, and comparison with Berlin, Bern, etc. Seven irregularities are found in the annual curve at Vienna, but no cold period in May. Statistics of days with large minimum departure from the normal show three maxima in the frequency of such days during May, one of them falling on the 11th–12th. As to cold periods in May in general, the author emphasizes the fact that these have attracted special attention merely because they coincide with a critical period in the growth of vegetation.

Mitchell, Arthur.

Weather of May. Good words. London, New York, **7**, 1866, p. 336–344.

Includes an account of the cold period in May (ice saints) as described by continental meteorologists, and a corresponding period in Scotland, presenting some of the data subsequently published by Buchan. (*Vide infra*, 1869.)

Sainte-Claire Deville, C. J.

Sur les variations périodiques de la température dans les mois de février, mai, août et novembre. (Cinquième note.) Comptes rendus de l'Académie des sciences, Paris, **62**, 1866, p. 1149–1157; 1209–1213.

Deals with certain alleged correspondences between the temperatures of like dates in February, May, August, and November, as well as other apparent examples of periodicity symmetrically arranged through the year.

Sainte-Claire Deville, C. J.

Sur les variations périodiques de la température dans les mois de février, mai, août et novembre. (Sixième note.) Comptes rendus de l'Académie des sciences, Paris, **62,** 1866, p. 1298–1305.

The author finds periodic variations in barometric pressure corresponding to those which he has previously found for temperature.

Sainte-Claire Deville, C. J.

Sur les variations périodiques de la température dans les mois de février, mai, août et novembre. (Septième note.) Comptes rendus de l'Académie des sciences, Paris, **63**, 1866, p. 1030–1038.

Develops further the idea set forth in his fifth note that the mean temperature derived from the temperature of four dates of the year, equally distant from each other, either in time or in angular distance traveled by the earth in its orbit, serves to show certain recurrent fluctuations. Thus from several long temperature records (Paris, London, Berlin) it appears that there are two recurrent dips in the temperature curve, one having its center at the quadruple date January 23, April 25, July 27, October 26; the other at the quadruple date February 12, May 14, August 16, November 15.

1867.

Buchan, Alexander.

Interruptions in the regular rise and fall of temperature in the course of the year, as shown by observations made in Scotland during the past ten years, 1857–66. Journal of the Scottish meteorological society, Edinburgh, new ser., **2**, 1867–1869, p. 4–15; 41–51; 107–112.

Records of five selected stations in Scotland show five recurrent cold periods (Feb. 7–14, Apr. 11–14, May 9–14, June 29–July 4, Aug. 6–11, Nov. 6–13) and three recurrent warm periods (July 12–15, Aug. 12–15, Dec. 3–14). The cold period in April corresponds to the "borrowing days" of folklore (making allowance for the change from the Julian to the Gregorian calendar).

Sainte-Claire Deville, C. J.

Sur les variations périodiques de la temperature. (Huitième note.) Comptes rendus de l'Académie des sciences, Paris, **64**, 1867, p. 933–942.

Carrying further the method developed in his previous notes, the author averages the temperatures of 12 days spaced equally through the year, giving the temperature of a "jour dodécuple." Curves based on values of successive "jours dodécuples" show a minimum corresponding to about the 10th–14th of each month, preceded and followed by maxima; the whole constituting a sort of monthly "oscillation."

Willet, J. E.

Indian summer. American journal of science and arts. New Haven, (2) **44**, 1867, p. 340–347.

Deals chiefly with the smokiness of the atmosphere during Indian summer.

1868.

Buchan, Alexander.

Handy book of meteorology. 2d ed. Edinburgh, London, 1868. Interruptions of temperature, p. 140–142.

Sainte-Claire Deville, C. J.

Des variations comparées de la température et de la pression atmosphériques. Comptes rendus de l'Académie des sciences, Paris, 67, 1868, p. 574–580.

Abstract. Deals with barometric fluctuations corresponding to the temperature fluctuations described in previous notes.

1869.

Quetelet, Ernest.

Mémoire sur la température de l'air à Bruxelles. Mémoires de l'Académie royale de Belgique. Bruxelles, **36**, 1869.

Discusses irregularities in the annual temperature curve, p. 54–60, and says that their recurrence has not been established.

1870.

Dove, H. W.

Über die Zurückführung der jährlichen Temperaturcurve auf die ihr zum Grunde liegenden Bedingungen. Monatsbericht der Königl. Akademie der Wissenschaften, Berlin, 2 Juni. 1870, p. 365–379. Also published in Zeitschrift der österreichischen Gesellschaft für Meteorologie, Wien, **6**, 1871, p. 1–6.

Discusses the depression of temperature in May, and also the more marked depression in June, coinciding with the beginning of the rainy season in Germany. These are attributed to incursions of the cold polar air current, blowing from the Atlantic and from North America, where winter conditions last longer than in Europe. The northeastern seaboard of North America remains cool under the influence of floating ice from the polar regions.

1872.

Burckhardt, E.

The cold week in May. Report of the Rugby school natural history society for the 1871. Rugby, 1872, p. 25–29.

Amateurish presentation of Erman's meteorite hypothesis, without credit to Erman or other authority.

1875.

Sainte-Claire Deville, C. J.

Sur les variations ou inégalités périodiques de la température (dixième note): Période du vingtième jour dodécuple. Comptes rendus de l'Académie des sciences, Paris, **80**, 1875, p. 714–721.

Mainly a résumé of the author's previous notes, to introduce a new method of discussion.

Sainte-Claire Deville, C. J.

Sur les variations ou inégalités périodiques de la température (Onzième note); période du vingtième jour dodécuple. Novembre. Comptes rendus de l'Académie des sciences, Paris, **80**, 1875, p. 939–948; **82**, 1876, p. 540–545.

This note was intended to be the first of a series in which, instead of using the composite temperatures of "jour dodécuples," the author proposed to study, for each month in the year separately, the temperature oscillations which he believed to have their minima at regular intervals throughout the year (corresponding to different dates in the different months, on account of the irregularities of the calendar, but always falling between the 7th and the 17th), and the way in which these oscillations vary from year to year. In this note the oscillation of November is discussed, and it is shown to have occurred conspicuously in 1873 and 1874 at stations in Europe, northern Africa, and North America. The series of notes was not carried further, as the author died in 1876.

1876.

Bobynine, V.

Sur l'oscillation de la mi-novembre, observée à Nijni-Novgorod. Comptes rendus de l'Académie des sciences, Paris, **82**, 1876, p. 1108–1111.

Temperature curve for Nijni-Novgorod, 1874, and mean curve for 1870–74, shows marked oscillation in the middle of November corresponding to that found by Sainte-Claire Deville for European stations.

Hellmann, Gustav.

Ueber die Sommerregenzeit Deutschlands. Annalen der Physik und Chemie, Leipzig, **159**, 1876, p. 36–51.

A maximum of rainfall in June in northern Germany corresponds with a recurrent depression of temperature, more marked than that of the ice saints in May, due to cold northwest winds from the Atlantic, blowing toward a barometric depression formed over the warm continental interior. These cold winds also account for the maximum in rainfall.

Hinrichs, G.

Sur l'oscillation de la mi-novembre dans l'Amérique. Comptes rendus de l'Académie des sciences, Paris, **82**, 1876, p. 520–522.

Records at Iowa City, 1872–1875, show a rise of temperature, following a minimum, in mid-November, corresponding to that noted in Europe by Saint-Claire Deville. In 1874 this oscillation prevailed over a great part of Europe and the eastern United States.

Schott, Charles A.

Tables, distribution, and variations of the atmospheric temperature in the United States and some adjacent parts of America. Washington, 1876 (Smithsonian contributions to knowledge 277).

"Apparent interruptions in the regularity of the annual fluctuation," p. 183–197. Includes mean temperatures for each day of the year and curves of the mean annual march of temperature for several American stations, based on long records.

1877.

Billwiller, R.

Über die Kälterückfälle im Mai. Vierteljahresschrift der Naturforschenden Gesellschaft, Zürich, **22**, 1877, p. 207–208.

This brief paper probably contains the first attempt to explain the cold period in May on the basis of the information afforded by synoptic weather charts. The author shows that the northerly winds which produce the depression of temperature in question are due to a low-pressure area over southern or southeastern Europe, and he attributes this pressure distribution to the contrast in temperature between the northern and southern parts of the continent.

Hellmann, Gustav.

Ueber die Sommer-Regenzeit Deutschlands. Zeitschrift der österreichischen Gesellschaft für Meteorologie, Wien, **12**, 1877, p. 1–9.

Reprinted from Annalen der Physik. See above, 1876.

1880.

Scientific view of the Indian summer. Kansas City review, Kansas City, Mo., **3**, 1880, p. 486–487. From Philadelphia ledger.

Brief notice of Fitz Roy's explanation of Indian summer. (Cf. 1863.)

1881.

Assmann, Richard.

Die Nachtfröste des Monat Mai. Halle, 1885. (Reprinted, with additions, from Magdeburgischer Zeitung, June 19 & 21, 1881.)

The author presents and discusses weather maps showing the barometric conditions over Europe and the regions over which frosts occurred May 8–12, 1881. He explains the dependence of the frosts at this period upon the contrast between the thermal properties of ocean and land areas.

[Klein, H. J.]

Die Kälterückfälle im Mai. Gaea, Köln, Leipzig, **17**, 1881, p. 419–423.

A clear, popular account of the ice saints question, setting forth the views of Dove and more recent views, based on a knowledge of the circulation in cyclones.

1882.

Assmann, Richard.

Die Nachtfröste des Mai 1882. Magdeburgischer Zeitung, 1883.

Not consulted, but it is abstracted in Fortschritte der Physik, 1883. The author compares barometric conditions over Europe with the area in which frost occurred, on the dates May 5–20, for each year from 1877 to 1881. The cold period of the ice saints was quite regular in its time of occurrence, beginning over Scandinavia and thence following a course which the author describes over other parts of Europe.

Roche, Édouard.

Le climat actuel de Montpellier comparé aux observations du siècle dernier. Bulletin météorologique du Département de l'Hérault, année 1881, Montpellier, 1882, p. 37–92.

Compares the mean yearly march of temperature deduced from a long series of observations in the eighteenth century with that deduced from a modern series, and finds striking parallelism in the departures from a smooth curve, including some of the supposed recurrent irregularities found elsewhere in Europe. Includes detailed comparison with the Brussels curve.

Vincent, J.

Les hausses et les baisses thermométriques à date fixe. Ciel et terre, Bruxelles, **3**, 1882–83, p. 80–85.

The author states that the annual temperature curve based on the first half of the total record at Brussels is almost identical with that based on the second half; hence the irregularities must be real and permanent.

1883.

Bebber, W. J. van.

Die gestrengen Herren. Zeitschrift der österreichischen Gesellschaft für Meteorologie, Wien, **18**, 1883, p. 145–149.

Digest of recent papers by Assmann and Bezold with some new charts of mean isobars and temperature isanomals for the critical period of May and the month as a whole.

Bezold, Wilhelm von.

Bemerkungen zu der Abhandlung des Herrn Dr. van Bebber über "die gestrengen Herren." Zeitschrift der österreichischen Gesellschaft für Meteorologie, Wein, **18**, 1883, p. 418–423.

Deals chiefly with the question of priority in the presentation of views.

Bezold, Wilhelm von.

Die Kälterückfälle im Mai. Abhandlungen der K. bayerische Akademie der Wissenschaften, München, 2 Abt., **14**, 1883, p. 69–107.

In the years 1879–1882 the temperature depressions of May in central Europe occurred when a high-pressure area lay to the west and a low-pressure area in the east or southeast. The author proceeds to consider average conditions in May, as based on long records at European stations. In the absence of a large number of long records of pressure, he assumes that, as pointed out by Wild, the isobars in general coincide with temperature isanomals; i. e., an area of low pressure coincides with an area of maximum thermal anomaly and vice versa. Using the data computed by Dove and Jelinek, he finds that an area of maximum thermal anomaly develops over the plains of Hungary in the third pentad of May. The formation of a barometric depression in the same region and at the same period is therefore believed to be a normal feature of the climate. This would give cold northerly winds over Germany.

Hellmann, G.

Ueber den jährlichen Gang der Temperatur in Norddeutschland. Zeitschrift des K. preussischen statistischen Bureau, Jahrgang 1883.

Compares annual march of temperature at 25 stations as deduced from five-day means during a period of 35 years; also presents curve for Breslau based on a 92-year record. Besides discussing the irregularities shown in the long-year averages, the author determines for Breslau the probability, in percentage, of the occurrence of a "Kälterückfall" during each pentad from January 16 to July 29, and of a "Wärmerückfall" during each pentad from August 4 to January 10. The greatest probability of such irregularities is found in the pentads January 16–30, February 5–14, March 12–16, May 11–15, June 15–19, July 10–14, July 25–29, August 14–18, September 23–October 2, December 27–January 5. The author also shows for the various stations the greatest positive and the greatest negative irregularity that has occurred during each pentad of the year.

1884.

Billwiller, R.

Die Kälterückfälle im Mai. Zeitschrift der österreichischen Gesellschaft für Meteorologie, Wien, **19**, 1884, p. 245–246.

The problem of determining why the cold period in May is characteristic of particular dates hardly exists as there is really a wide range in the time of occurrence.

Hegyfoky, Kabos.

Die "gestrengen Herren" in Ungarn. Zeitschrift der österreichischen Gesellschaft für Meteorologie, Wien, **19**, 1884, p. 80.

Brief preliminary note, showing a slight depression in the mean temperature curve at 28 Hungarian stations in the second (not third) pentad of May.

Köppen, W.

Zur Frage der "gestrengen Herren." Zeitschrift der österreichischen Gesellschaft für Meteorologie, Wien, **19**, 1884, p. 183–185.

Points out that while Assmann, Bezold, and others have described the barometric conditions that give rise to temperature depressions in May, they have not explained why these barometric conditions tend to recur at particular dates. Suggests that it may be necessary to invoke cosmical factors.

Köppen, W., Hann, J., & Buys-Ballot, C. H. D.

Zur "Eismänner"-Frage. Zeitschrift der österreichischen Gesellschaft für Meteorologie, Wien, **19**, 1884, p. 320–325.

Letters from Köppen and Buys-Ballot and quotation from Hann, dealing with the questions, Does the barometric situation producing a cold period in May show a marked tendency to prevail on particular dates, and, if so, why?

Krankenhagen.

Vertheilung des Luftdrucks über Mittel-Europa im Juni. Meteorologische Zeitschrift, Berlin, **1**, 1884, p. 11–15.

Describes and charts the barometric conditions over Europe for each pentad of June (mean values for 1876–1883), with special reference to those which lead to a depression of temperature characteristic of the third pentad.

Krankenhagen.

Zur Charakteristik der dritten Mai-Pentade. Meteorologische Zeitschrift, Berlin, **1**, 1884, p. 371–373.

Suggests that the bad reputation of the third pentad of May (ice saints) may be due to more intense rather than more frequent frosts at that period. A note appended to this paper by W. Köppen contains a handy résumé of positive knowledge and outstanding questions concerning the May frosts.

1885.

Abercromby, Ralph.

Principles of forecasting by means of weather charts. 2d ed., London, 1885.

Discusses "recurrence," p. 65–67.

Buys Ballot, C. H. D.

The anomalies in the annual range of temperature. How to detect them. Quarterly journal of the Royal meteorological society, London, **11**, 1885, p. 104–118.

Shows that, on account of the widely different temperatures of a given date from year to year, only very long records could show conclusively the existence of recurrent anomalies.

Hromádko.

Kälterückfälle im Mai in Tabor. Zeitschrift der österreichischen Gesellschaft für Meteorologie, Wien, **20**, 1885, p. 234.

Brief note. Observations at Tabor, Bohemia, 1875–1885, show a decided preponderance of temperature depressions in the third pentad of May.

Jamin, J.

Sur le rayonnement nocturne. Comptes rendus de l'Académie des sciences, Paris, **100**, 1885, p. 1273–1276.

Discusses "la lune rousse" and "les saints de glace." Attributes prevalence of frosts at the period in question to a spring minimum of atmospheric humidity, and consequent maximum of nocturnal radiation. This article is reviewed and severely criticized in Zeit. der öst. Ges. f. Meteor, Wien, **20**, 1885, p. 269–272.

Ney, C. E.

Der vegetative Warmeverbrauch und sein Einfluss auf die Temperaturverhältnisse der Luft. Meteorologische Zeitschrift, Berlin, **2**, 1885, p. 445–451.

Author suggests that the cold period in May is due to evaporation from newly expanded foliage.

Vincent, J.

Les saints de glace. Ciel et terre, Bruxelles, (2) **1**, 1885–86, p. 145–151.

Describes barometric conditions associated with cold period in May.

1886.

Hegyfoky, Kabos.

A májushavi meteorológiai viszonyok magyarországon. Die meteorologischen Verhältnisse des Monats Mai in Ungarn. Budapest, 1886.

An elaborate study showing, among other things, that much more ample data than those cited by Bezold (1883) do *not* indicate a maximum thermal anomaly at Hungarian stations during the second pentad of May.

Hegyfoky, Kabos.

Zur Temperatur der Eismänner. Wetter, Magdeburg, **2**, 1886, p. 89–90.

Temperature record for Budapest does not show the sudden increase in thermal anomaly in the third pentad of May assumed by Bezold in his memoir of 1883.

Lancaster, A.

L'été de la Saint-Martin. Ciel et terre, Bruxelles, (2) **2**, 1886–1887, p. 447–454.

Temperature records of Belgium, France and central Germany show that the period about Nov. 11 (St. Martin's day) is, on an average, unseasonably cold rather than unseasonably warm.

Petermann, R. E.

Die Kälterückfälle im Mai. Wetter, Magdeburg, **2**, 1886, p. 105–111.

Reprint, Wiener Freie Presse.

Points out, on the basis of Hann's discussion of the Vienna temperature record (Sitzb. Wien Akad. (2) **76**, 1877, p. 685–736) that cold periods are not more likely to occur during the third pentad of May (ice saints) than at other times in the month.

1889.

Owen, Richard.

Indian summer. American meteorological journal, Ann Arbor, Mich., **6**, 1889–90, p. 392–394.

Unimportant.

Plowshare, John.

Indian summer. American meteorological journal, Ann Arbor, Mich., **6**, 1889–90, p. 530–531.

Smokiness of Indian summer has disappeared with the passing of the Indians, who formerly burned the prairie grasses every autumn.

Renou, E.

Études sur le climat de Paris. Troisième partie. Température. Annales du Bureau central météorologique de France, année 1887, I. Mémoires. Paris, 1889, p. B. 195–B. 226.

Presents yearly temperature curve for Paris based on a 130-year record, and discusses briefly the subject of recurrent irregularities (p. B. 206–207).

1892.

Schwalbe, Gustav.

Über die Maxima und Mimima der Jahreskurve der Temperatur. Inaug.-Diss. Berlin, 1892.

The author maintains that irregularities in the yearly temperature curve rarely occur in the individual years on the dates at which they are found in the average curve deduced from a many-year record.

1893.

Dufour, Ch.

Le mouvement progressif de l'abaissement de la température du milieu de mai. Bulletin de la Société vaudoise des sciences naturelles, Lausanne, (3) **29**, 1893, p. 316–320.

Although a temperature depression between May 12 and 16 is only slightly noticeable in the curves based on certain long records (Brussels, Geneva, etc.), it appears from the examination of individual years to be quite a regular feature of the climate. As pointed out in earlier literature, the cold period occurs later as we go southward, and also become less pronounced, the average date ranging from May 5 at Archangel to May 12–16 in France and Switzerland, and May 19 at Naples. Connection with the movement of icebergs is suggested.

1898.

Hennig, Richard.

Untersuchungen über die "kalten Tage" des Mai. Wetter, Berlin, **15**, 1898, p. 85–89; 106–109; 131–138; 145–156.

Shows that during 25 years the time of occurrence of a marked cold period ranged from April 30 to June 1. Discusses attendant barometric conditions.

Müttrich.

Ueber Spät-und Frühfröste. Zeitschrift für Forst- und Jagdwesen, Berlin, **30**, 1898, p. 201–233.

Discusses the frequency of late and early frosts at 16 forest meteorological stations as shown by records of from 13 to 20 years. Frosts are more frequent and more severe May 10–13 than on the days just preceding that period and on the days following.

Rijckevorsel, Elie van.

On the temperature of Europe. London, Edinburgh, and Dublin philosophical magazine and journal of science, London. (5) **45**, 1898, p. 459–467.

The author has drawn and compared mean annual temperature curves for a great number of stations, mostly in Europe, based on daily values. Although the data were extensively smoothed (by a sort of bloxaming process), and although the records varied greatly in length and pertained to widely different epochs, they show, according to the writer, a remarkable similarity. Especially within the triangle Valentia, Königsberg, Catania, the curves are said to have "identically the same irregularities." The downward slope of the ice saints is said to be apparent for Rome, Palermo, Biskra (Algeria), and Constantinople. Eastern Europe has a different type of curve from western, but the author finds a "striking similarity" between parts of the curves for Constantinople and Archangel. He suggests that some of the irregularities in these curves may be found in Asia and America, and that "we ought then to look for the explanation beyond the limits of our globe."

1899.

Bezold, Wilhelm von.

Bemerkungen zu der Abhandlung des Herrn Müttrich: "Ueber Spät- und Frühfröste." Meteorologische Zeitschrift, Wien, **16**, 1899, p. 114–117.

Taking the data discussed by Müttrich (*vide infra*) and comparing three-day periods for May, the increased frequency of frosts May 11–13 becomes even more pronounced. This cold period is less evident in the record of mean daily temperatures, owing to the frequent occurrence of high daytime temperatures on days with frost.

1900.

Barnard, R. J. A.

The annual march of temperature. London, Edinburgh, and Dublin philosophical magazine and journal of science, London, (5) **50**, 1900, p. 408–409.

Compares the annual curve of temperature for 1859–1878 at Melbourne, Australia, with the curve for 1879–1898 at the same station. Though these two halves of the total 40-year record do not show such definite agreement as Rijckevorsel has found for European stations, there are some striking similarities.

Hellmann, G.

Zur Frage der "gestrengen Herren" oder "Eismänner." Meteorologische Zeitschrift. Wien, **17**, 1900 p. 333–335.

The tradition of the ice saints antedates the introduction of the Gregorian calendar. Hence there has been some confusion as to the period to which it applies. It also dates from a time when only a few days in the month were dedicated to particular saints, so that the traditional weather of a certain saint's day (e. g., St. Servatius) must be interpreted broadly as belonging to a considerable part of the month.

Hergesell, H.

Ergebnisse der internationalen Ballonfahrten. Meteorologische Zeitschrift, Wien, **17**, 1900, p. 1–28.

Balloon observations at various places in Europe on May 13, 1897, show (p. 16) that the temperature distribution characteristic of the ice saints was even more pronounced at high levels than near the surface. The contrast between low temperatures in the west and high in the east and northeast was found up to more than 10,000 meters.

Kremser, V.

Beiträge zur Frage der Kalterückfälle im Mai. Meteorologische Zeitschrift, Wien, **17**, 1900, p. 209–214.

Records at three German stations show a pronounced maximum of frost temperatures, during *certain decades*, for the three-day period May 11–13, both in the mean of the whole decade and in most of the individual years. Records extending back many years, however, do not show the same feature, but show a regular decrease in frequency of frosts from the beginning to the end of May. Hence the cold period of the ice saints either is not a permanent feature of the climate or else it is a periodic one. In the latter case it might have occurred so persistently during certain series of years as to attract public attention and give rise to the belief in its recurrence.

Rudel, K.

Zur Frage des Auftretens der Eismänner in Bayern. Meteorologische Zeitschrift, Wien, **17**, 1900, p. 373–375.

Records of Bavarian stations do not show that frosts are especially frequent on the dates of the ice saints.

1901

Lancaster, A.

Les refroidissements périodiques de mai. Ciel et terre, Bruxelles, **22**, 1901–02, p. 205–209; **23**, 1902–03, p. 111–119.

The annual temperature curve at Brussels and also at several other places (Edinburgh, Berlin, etc.) shows a number of cool periods in May as pronounced as that of the ice saints, or more so, indicating a more or less regular "rhythm", of short period, in the march of temperature.

MacDowall, A. B.

Recurrence of cold and warm weeks. Symons's meteorological magazine, London, **36**, 1901, p. 21.

Points out some weekly and monthly recurrences in the Greenwich records.

1902.

Abbe, Cleveland.

Indian summer. Science, New York, new ser., **15**, 1902, p. 793.

Brief note. Deals with name only.

Abercromby, Ralph.

Weather. A popular exposition of the nature of weather changes from day to day. London, 1902.

Recurrent types of weather, p. 312–317.

Lancaster, A.

Un intéressant phénomène. Les refroidissements du milieu de juin depuis vingt ans. Ciel et terre, Bruxelles, **23**, 1902–03, p. 231–233. Note complémentaire, p. 311–313.

Cold period, with frost, toward the middle of June occurred frequently in recent years of the Brussels record, but seldom in early years.

"Note complémentaire" contains further details regarding the relative frequency of cold periods in May shown by old and recent records for Brussels. Points out a corresponding change in the barometric curve.

Luizet, M.

Sur les perturbations périodiques de la température en juin et en décembre. Ciel et terre, Bruxelles, **23**, 1902–03, p. 415–419.

Calls attention to some recurrent irregularities in the temperature curve for June and December at Lyon. A note by Lancaster appended to this article shows resemblance between Lyon and Brussels curves.

Marten, Wilhelm.

Über die Kälterückfälle im Juni. Inaug.-Diss. Berlin, 1902. Also published as Abhandlungen des K. preuss. meteorologischen Instituts, Berlin, **2**, no. 3, 1902.

A fall in temperature in the second decade of June is found to be characteristic of a region of Europe extending from England and France over western Russia to the Black Sea. It advances from northwest to southeast, increasing in intensity. It is due to the transportation of masses of cold air in connection with a characteristic distribution of pressure. The recurrence of these pressure conditions can not yet be fully explained, but the explanation is probably to be sought in the general circulation of the atmosphere, coupled with the thermal contrasts between land and water.

Matthews, Albert.

The term Indian summer. U. S. Weather bureau, Monthly weather review, Washington, **30**, 1902, p. 19–28; 69–79.

This valuable memoir discusses the history of the term "Indian summer" but deals only incidentally with the phenomenon itself.

Murat, I. St.

Clima ḑileĭ de ḑece maiŭ. Analele, Academieĭ Române. Bucuresci, (2) **25**, 1902.

Study of the weather of May 10 (a Roumanian national holiday) during 25 years. The author finds that while depressions of temperature occur in Roumania on the days of the ice saints (May 10–12) they are not a more characteristic phenomenon than depressions occurring on other dates in May. Cold weather tends to occur at intervals of seven days in that month.

1903.

Barbé, G.

Sur la question des saints de glace des 11–13 mai. Annuaire de la Société météorologique de France, Paris, **51**, 1903, p. 137–142.

Mainly a résumé of publications by Müttrich, Bezold, Kremser, Gautier and Duaime, etc., with some remarks on the correspondance of dates between the Julian and Gregorian calendars, in relation to the ice saints.

Gautier, Raoul, & Duaime, Henri.

Quelques chiffres relatifs aux saints de glace. Archives des sciences physiques et naturelles, Genève, (4) **15**, 1903, p. 545–557.

Discussion of a 75-year temperature record for Geneva shows a wide variation in the time of occurrence of temperature depressions during May. Certain groups of years suggest recurrence; but the mean of the whole record shows a regular rise of temperature through the month. The general conclusion agrees with that reached by Kremser (1900) in his discussion of German records.

Maurer, H.

Zur Frage der "gestreugen Herren" oder "Eismänner." Meteorologische Zeitschrift, Wien, **20**, 1903, p. 176–178.

Date of St. Servatius day (one of the ice saints) as affected by the change from the Julian to the Gregorian calendar.

Moureaux, Th.

Sur les refroidissements et les réchauffements de la température en juin. Annuaire de la Société météorologique de France, Paris, **51**, 1903, p. 117–118.

Points out contradictory evidence as to occurrence of warm and cold periods in June obtained from different periods of years at Paris and Brussels.

Les refroidissements périodiques de mai et de juin. Ciel et terre, Bruxelles, **24**, 1903–04, p. 166–168.

Abstract of some recent literature.

1904.

Friesenhof, Gregor.

Die Temperatur-Depressionen im Monate Mai, zugleich ein Beitrag zur Frage der Eismännerperiode und des Urban. Meteorologische Zeitschrift, Wien, **21**, 1904, p. 232–235.

The record of daily minimum temperatures at the Neutratal observatory (Hungary) shows that there are six periods in May characterized by temperature depressions, the largest number of low temperatures occurring May 1–3 and the next largest May 12–15 (ice saints).

Indian summer. Scientific American, New York, **91**, 1904, p. 330.

Includes unscientific and erroneous explanations.

Moureaux, T.

Résumé de trente années d'observations météorologiques á l'observatoire du Parc Saint-Maur (1874–1903). Annuaire de la Société météorologique de France, Paris, **52**, 1904, p. 233–242.

Brief notice of irregularities found in the annual temperature curve, p. 241–242.

1905.

Jochimsen, C.

Die Kälterückfälle im Mai. Wetter, Berlin, **22**, 1905, p. 256–259.

Temperature record at Neumünster 1898–1905 shows wide range in time of occurrence of cold periods during May.

Rijckevorsel, Elie van.

Konstant auftretende secundäre Maxima und Minima in dem jährlichen Verlauf der meteorologischen Erscheinungen. Abt. 1–11. Rotterdam, 1905–1913; Utrecht, 1913–1917. (Abt. 9–11 published as K. nederlandsch meteorologisch instituut, No. 102, Mededeelingen en Verhandelingen, 16,17, 22.)

The author develops in this large work the ideas set forth in his memoir of 1898, cited above. In the first two parts, both published in 1905, he presents tabulated data and curves showing the annual march of temperature at a great number of stations throughout the world. Certain other meteorological and nonmeteorological statistics are presented, including sunspot data. The temperature records are of various length, some more than 100 years, and the mean daily temperatures used in constructing the curves are smoothed (bloxamed). As in his previous paper, he finds that the secondary maxima and minima, having periods of a few days, are essentially world-wide phenomena, pointing to a cosmical origin. On this assumption he constructs what he calls "normal curves;" one for a European area, one for each hemisphere, etc. In order to make the secondary maxima and minima more apparent, he eliminates from these normal curves the annual temperature wave, so that the curves become irregular horizontal lines. Finally, from the normal curves of the two hemispheres he eliminates further an alleged semiannual wave, and then combines these curves to obtain a normal curve for the world as a whole. In subsequent parts of the work, which is still in course of publication, he has dealt in an analogous way with barometric pressure, rainfall, vital statistics, sunspots, and terrestrial magnetism.

1906.

Kremser, V.

Fünfzigjährige Pentadenmittel der Lufttemperatur für Norddeutschland. K. Preussisches meteorologisches Institut, Ergebnisse der Beobachtungen an den Stationen II. und III. Ordnung im Jahre 1900, zugleich Deutsches meteorologisches Jahrbuch für 1900, Berlin, 1906, p. xvii–xxiv.

Discusses the annual march of temperature at stations in northern Germany as based on 50-year records and compares results with those previously found by Hellmann in his discussion of 35-year records. Some of the irregularities previously found disappear in the mean of the longer record. The cold period in June persists, but chiefly at inland stations.

Millot, C.

L'été de la Saint-Martin à Nancy. Bulletin de la Société des sciences, Nancy, (3) **7**, 1906, p. 135–137. Also published (except for tables) in Annuaire de la Société météorologique de France, Paris, **54**, 1906, p. 237–241.

"En résumé, l'été de la Saint-Martin considéré comme un regain temporaire de chaleur existe réellement à Nancy, quoique assez peu accentué; mais le froid de la Toussaint qui le précède contribue à en exagérer l'importance par contraste."

1907.

Fassig, O. L.

Report on the climate and weather of Baltimore and vicinity. Maryland weather service, Baltimore, **2**, 1907.

Irregularities in the annual temperature curve discussed on p. 80–82. As to the temperature in May, it is stated that "there is a distinct rise from the 9th to the 12th in place of the European fall" and a similar rise is found in the temperature curves for Washington, Norfolk, Nashville, and Columbus. "A probable explanation of this phenomenon may be found in a periodic recurrence at this time of an area of high barometric pressure over the South Atlantic States, or an extension westward of the permanent area of high pressure over the North Atlantic in latitude of about 30° in conjunction with the development of a barometric depression in the Mississippi Valley."—p. 81.

Hörmann, Ludwig von.

Wetterherren uud Wetterfrauen in den Alpen. Zeitschrift des deutschen und österreichischen Alpenvereins, München, **38**, 1907, p. 93–114.

Includes folklore relating to the ice saints.

Jochimsen, C.

Die Kälterückfälle im Juni mit besonderer Berücksichtigung der Provinz Posen. Landwirthschaftliches Centralblatt für Deutschland, Berlin, **35**, 1907, p. 237–239.

Not consulted.

1908.

Hecker, Alfred.

Die gestrengen Herren. Mitteilung aus dem Institut für Bodenlehre und Pflanzenbau der K. landwirtschaftl. Akademie Bonn-Poppeldorf. Landwirtschaftliche Jahrbücher, Berlin, **37,** 1908, p. 711–729.

After a comprehensive history of previous investigations, the author gives an elaborate analysis of a 60-year temperature record for Bonn, in which daily means are given for various groups of years, etc. The general conclusion is that while temperature depressions occur in May almost any year, they are not especially characteristic of the dates of the ice saints.

Lancaster, A.

Les "saints de glace" en 1907. Ciel et terre. Bruxelles, **28,** 1907–1908, p. 179–180.

Abnormally warm weather occurred in Belgium on the days of the ice saints in 1907.

Luizet, M.

Sur les saints de glace et l'été de Saint-Martin. Association française pour l'avancement des sciences, Compte rendu de la 36me session, Reims, 1907, Paris, 1908, p. 256–260.

A comparison of temperature records at Lyon, during May and November, for the period 1851–1878 and the period 1881–1906, showing a striking *dissimilarity* in the curves in both cases. Combining the early and recent records tends largely to smooth out the irregularities.

Musy.

Les retours de froid au milieu de mai. Bulletin de la Société des sciences naturelles, Fribourg, **16,** 1908, p. 62–65.

Not consulted.

1909.

Jochimsen, C.

Die gestrengen Herren oder die Eisheiligen des Mai mit besonderer Berücksichtigung der Provinz Brandenburg. Landbote, Prenzlau, **30,** 1909, p. 405–410.

Not consulted.

Mossman, R. C.

The cold period of May in arctic and antarctic regions, with special reference to 1903. Symons's meteorological magazine, London. **44,** 1909, p. 1–6.

The author states that the cold period in May occurs in both hemispheres, including the arctic and antarctic regions. It was well marked in the antarctic during the expeditions of 1899, 1902, and 1903. "It is specially marked in Argentina and Chile in the southern, and over the greater part of Europe in the northern hemisphere. It is absent or but feebly developed in S. America south of 40° S. At all places where it occurs it is associated with high pressure, and the anticyclonic conditions relative to the normal are most pronounced in Antarctica. At places where it does not occur cyclonic conditions prevail. This cold period is followed by a great rise of temperature in the northern, and a slight rise in the southern hemisphere, which is most abnormal, occurring, as it does, within four weeks of the winter solstice in the southern hemisphere. So regular a feature is the cold period of May at the South Orkneys that in only one year (1906) since the station was established in March, 1903, has it failed to make its appearance."—p. 3.

Not only this particular interruption of temperature, says the author, but warm and cold periods in general are synchronous in both hemispheres, and are probably due to interrelations between the northern and southern centers of action.

1910.

Gautier, Raoul.

Sur le retour de froid en juin. Verhandlungen der schweizerischen naturforschenden Gesellschaft, Basel, **93,** 1910, p. 328.

Brief abstract. Records of recent years at Geneva and Grand St. Bernard show a marked cold period in the second decade of June, but it it not found in the records of earlier years.

1911.

Gautier, Raoul, & Duaime, Henri.

Les retours de froid en juin à Genève et au Grand Saint-Bernard. Archives des sciences physiques et naturelles, Genève (4) **31,** 1911, p. 497–508.

The recurrent cold period in June is found in the Geneva record since the middle of the nineteenth century, but not, in general, in the earlier records, running back to 1796. Nearly similar results for Grand St. Bernard. Hence the phenomenon seems to undergo a secular change.

Lehmann, Artur.

Altweibersommer. Die Wärmerückfälle des Herbstes in Mitteleuropa. Landwirtschaftliche Jahrbücher, Zeitschrift für wissenschaftliche Landwirtschaft, Berlin, **41,** 1911, p. 57–129.

The leading account of the warm period or periods in Europe corresponding to the Indian summer of America (known under about 25 names, of which the author gives a list). The folklore of the subject is discussed, and an account is also given of the gossamer which floats in the air in the autumn and bears the same name as the period in question (*Altweibersommer*). The weather and barometric conditions over Europe in September and October are described, year by year, from 1890 to 1908. The author finds that weather of the Indian summer type is most frequent over central Europe in the fifty-fifth pentad of the year (Sept. 28–Oct. 2), and is associated with a widespread area of high barometric pressure over the continent, somewhat east of its center, bringing mild southeasterly winds to the region mentioned, together with clear skies, favoring strong insolation during the day. These conditions may last from a few days to three or four weeks.

Morrow, Josiah.

Indian summer. U. S. Weather bureau. Monthly weather review, Washington, **39,** 1911, p. 469–470.

Deals with name only.

1912.

Meissner, Otto.

Die Kälte- und Wärmeperioden des Jahres, erläutert an den Potsdamer meteorologischen Beobachtungen. Wetter, Berlin, **29,** 1912, p. 81–84; 97–109; 158–162; 176–183.

In a 16-year record for Potsdam the author finds 10 cold periods and 7 warm periods. He gives the average dates and duration of each, attendant winds and other conditions, etc. The most reliable of these unseasonable spells is a period of cold, rainy weather in September, which occurred in every year of the record; average dates, September 8–16. It never began later than the 16th. This is one of the very few meteorological publications in which the dog days are mentioned as a feature of the annual temperature curve.

1913.

Almstedt, Karl.

Die Kälterückfälle im Mai und Juni. Inaug.-Diss. Göttingen, 1913.

Comprehensive study of the depressions in May and June found in the mean annual temperature curves of several European stations and of the mean barometric and wind conditions pertaining to the same periods. With respect to the supposed recurrent cold period in June, the author maintains that this is not a brief depression, but rather the beginning of a period extending through the summer in which, on account of monsoon winds, the temperatures are lower than they would be without these winds.

Indian summer at home and abroad. Scientific American, New York, **109,** 1913, p. 379.

Brief account, with notice of work by Lehmann.

"From a meteorological point of view, in Europe as in America, there are probably several 'Indian summers' in some years, while occasionally a year may have none. In other words, 'Indian summer' is merely a convenient designation for the most delightful of all types of autumn weather."

Rudel, Kaspar.

Juni-Kälterückfälle. Wetter, Berlin, **30,** 1913, p. 185–187.

List of marked cold periods in June at Nürnberg from 1879 to 1913.

Thraen, August.

Die Wärmedepressionen im Mai und ihr Einfluss auf den Niederschlag. Meteorologische Zeitschrift, Braunschweig, **30,** 1913, p. 380–386.

Records of the amount and frequency of rainfall at four German stations, differing considerably in altitude, exposure, etc., show the marked influence of the cold periods in May defined by Friesenhof (1904), one of these being the period of the ice saints.

1914.

Almstedt, K.

Die Kälterückfälle im Mai und Juni. Meteorologische Zeitschrift, Braunschweig, **31,** 1914, p. 426–433.

Abstract of his dissertation of 1913, above cited.

Flammarion, Camille.

L'été de la Saint-Martin. Bulletin de la Société astronomique de France, Paris, **28**, 1914, p. 487–490.

Analysis of temperature records for Juvisy (near Paris), 1901–1914, showing that the temperature does not tend to rise at the time of the November meteor shower (Leonids), November 14–17. There is also no recurrent rise of temperature on November 11 (St. Martin's day). Suggests that pictures of St. Martin sharing his cloak with a poor man may have given rise to the tradition concerning the weather of St. Martin's day.

Meissner, Otto.

Existieren die "Eisheiligen"? Wetter, Berlin, **31**, 1914, p. 176–179.

Records for Swinemünde, on the Baltic coast, 1898–1910, show a maximum frequency of NE. winds on May 10 (ice saints) and May 20–25 (little ice saints).

Schmidt, Albert.

Die Anomalien des jährlichen Temperaturganges und ihre Ursachen. Jahrbücher des Nassauischen Vereins für Naturkunde, Wiesbaden, **67**, 1914.

The author points out that temperature irregularities in the spring, when the "normal" temperature curve has a steep ascent, and in autumn, when it has a steep descent, are more likely to be smoothed out in the mean curve deduced from a long record than the irregularities of summer and winter, where the "normal" curve is approximately horizontal. This accounts for the greater prominence of the cold period in June as compared with those of April and May. He also shows that it is illogical to speak merely of abnormal *falls* of temperature in spring and abnormal *rises* of temperature in autumn, ignoring rises in spring and falls in autumn. The cause of the irregularities is found chiefly in the seasonal (semiannual) changes in great centers of action, and the irregularities are therefore most pronounced at the transition periods (spring and autumn) and over central Europe (lying between oceanic and continental regions of climate).

1915.

Hann, Julius von.

Lehrbuch der Meteorologie. 3d ed., Leipzig, 1915.

See pages 102–104. Handy digest, with references to the principal literature.

Talman, C. F.

Indian summer. U. S. Weather bureau, Monthly weather review, Washington, **43**, 1915, p. 44–45.

Deals with name only.

1916.

Ware, H. E.

Notes on the term Indian summer. Publications of the Colonial society of Massachusetts, Cambridge, Mass., **18**, 1916, p. 123–130.

Deals with name only.

Reed, W. G.

Indian summer and Plimsoll's mark. U. S. Weather bureau, Monthly weather review, Washington, **44**, 1916, p. 575.

Deals with name only.

1917.

Arctowski, Henryk.

Normal anomalies of the mean annual temperature variation. London, Edinburgh and Dublin philosophical magazine and journal of science, London, (6) **33**, 1917, p. 487–495.

The author finds that the irregularities in typical curves showing the annual march of temperature at stations throughout the world are steplike, as if the station had been shifted to a warmer or colder climate, or they are changes to a curve of larger or smaller amplitude, corresponding, respectively, to a continental or a marine climate. He also points out the "intimate relationship between very far distant stations," and concludes "that in a comparative study of the anomalies of the annual temperature variation, Teisserenc de Bort's conception of the great centres of action of atmospheric circulation will find an extensive application, because, although at present it would be premature to try to explain why it is that some changes of phase may occur simultaneously in Arctic and Antarctic regions, or in North America and Siberia, it seems impossible to conceive such correlations without supposing some relationship with the exchange of pressure between the seasonal and permanent centres of action."—p. 495.

Ryd, V. H.

On the computation of meteorological observations. Kjøbenhavn, 1917. (Publikationer fra det Danske meteorologiske Institut. Meddelelser Nr. 3.)

Chapter 7. Secondary minima and maxima in the annual variation of the temperature, p. 40–45. Criticizes the views of Dove and others as to the reality of the supposed recurrent cold period in May and other recurrent irregularities. If these are not real features of the climate they will gradually disappear as the period of observation grows longer. A comparison between the summer temperature curve at Copenhagen based on a record of 124 years and one based on a period of 25 years shows how the anomalies tend to be smoothed out in the longer record. The author also shows that the annual march of temperature may be accurately represented by a curve based on five-day means, according to a method of adjustment which he describes.

Forbes, W. E.

Ice saints. Annals of the Astronomical observatory of Harvard college, **83**, pt. 1, Cambridge, Mass., 1917, p. 53–59.

Analysis of a temperature record kept at New Bedford, Mass., 1813–1905, shows no definite recurrence of heat or cold about May 10. An instructive diagram shows the variability from year to year of the mean temperature for each date from May 7 to May 15.

RAINSTORM OF AUGUST 13–14, 1919, ON MARYLAND-DELAWARE PENINSULA.

By A. H. THIESSEN, Meteorologist.

[Dated: Baltimore, Md., Sept. 24, 1919.]

A rain and wind storm of unusual severity occurred on Wednesday, August 13–14, 1919, over the entire Maryland-Delaware Peninsula, resulting in immense damage to agriculture, roads, and bridges, and was the indirect cause of injury and death to several persons.

The morning weather map of August 13, 1919, showed a disturbance central off the Virginia coast moving northward, and the forecaster at the Central Office, Washington, D. C., ordered southeast storm warnings for the Atlantic coast from Delaware Breakwater to Boston. Rain began on the north Virginia coast about midnight of the 12th, and as the storm moved north the rain became general by 8 a. m. over the entire peninsula. At times it fell in torrents, but gradually diminished in intensity toward the end of the afternoon of the 13th, when it ended in the southern portion of the peninsula, but continued until early morning of the 14th in the northern portion. Heavy gales attended this rain, and the following maximum velocities were reported: 50 miles an hour at Norfolk, Va.; 60 on the beach at Atlantic City, N. J.; 35 at Cape May, N. J.; and 62 at Cape Henry, Va.

It is the general opinion that the destruction of property and crops was made easy due to the previous wet condition of the land, which was true, as very little loss of substantial buildings was reported, although numerous outbuildings and large shade and fruit trees were blown down or torn up by the roots, indicating that the anchoring was poor. The damage resulting from this storm was enormous and was variously estimated, but two or three million dollars would probably cover all material damage.

All standing crops were blown or beaten down to a greater or less extent. Corn was first blown down one way, and then when the wind changed was blown the other way and broken off, the tassels were whipped off and the blades shredded. Blossoms on late crops were blown from the plants, especially beans and tomatoes. Fruit trees were stripped of pears, peaches, and apples. Fields of tomatoes, cabbages, and potatoes were flooded, and truck in general was damaged by the wind and excessive rain. Wheat in the shock suffered, as it could not be moved, due to the miry condition of the ground. Potatoes just planted were a total loss. Many shade and fruit trees were split or blown to earth. Losses of cows, pigs, and poultry due to drowning were not inconsiderable.

Houses were injured by the wind driving in rain and thus damaging ceilings and walls. Milldams gave way and besides being a loss in themselves caused additional loss