Art. VIII.—Meteorological Phenomena Occasional and Periodical. By Fred. Allison, M. A., Chief Meteorological Agent, Halifax.

(Read May 13, 1878.)

Last year I had the honour of reading before this Institute a paper in which were noted many of the facts deduced from a long experience, and statistics of instrumental observations. These sheets contain a continuation of that series, embracing the chief recurring events of the seasons in animal and vegetable life; and those appearances in the clouds and disturbances in the atmosphere which from time to time are visible; and, though familiar and of frequent occurrence, are irregular, and governed by laws unknown to us at present. Of these, as well as of periodic events, I propose to give a summary of means, terms, and peculiarities, as observed by me in Nova Scotia.

To begin with occasional phenomena. The principal which we will discuss this evening are Gales—Lunar and Solar Halos and Coronæ—Fogs—Dews and Hoar Frosts—Thunders and Lightnings—Hails—Rainbows—and days of Sleighing; adding a few words to the remarks made here by me in 1869 concerning the Aurora Borealis (vide Transactions of N. S. I. of N. S. Vol. II. Part III.)

The Gales of Nova Scotia were noticed in my preceding paper, among instrumental observations of wind force (vide Transactions of this Institute, Vol. IV. Part III.) so little more need be said now. But, apart from the excessive velocity of the wind, a Gale must be considered as a Phenomenon due to widely extended atmospheric disturbance. It is commonly agreed that 30 miles per hour is the least Gale rate; 80 miles per hour has been reported from different out stations of this Province; but in Halifax (as before said) I have never recorded above 63. Last year was wonderfully quiet, scoring but 12 Gales, whereas 20 is the annual average. For farther details I again refer to my communication of last May.

All Halos and Coronæ round the Sun and Moon are in-

teresting in their formation and connections, but care must be taken to distinguish between these very different "rings." As is well known to most here, Halos are the large circles, generally 45°, frequently 90° in diameter. They proceed from the prismatic particles of ice in the higher strata of atmosphere, and the colours which often tint them are the effects of refracted rays of light; Red naturally appearing on the inside of the circle; because a very low temperature of the upper air is betokened by the Halo, and because this heavier cold air descending compresses the moisture hitherto held in the warmer lower strata. Wet weather is commonly looked for after this Phenomenon. But it does not necessarily follow. The temperature of the mingled currents may become so gradually assimilated as to avoid Precipitation. Or a wind draught induced by other causes may carry off the colder air, or give space for a still warmer rush of heat; in either of which cases the power of precipitating moisture would be annihilated.—The smaller rings, or Coronæ, are merely the effects of light passing over the Sun's or Moon's face, and are 8 or 10° in diameter. When coloured the Red is on the *outside*, being reflected. The same effect may be seen in dust round any luminous object. In the more intense light of the sun, solar circles are much less visible. Winter is the general season for Lunar Halos. From April to October they are very rare, while here they average 10 appearances during the remaining months.

Fog—or complete saturation of the atmosphere, when the wet and dry bulbs of the thermometer stand together, and no evaporation takes place—is common enough on all the coasts of our Peninsula, though almost unknown beyond the sea slopes. Owing to the frequent great difference in temperature between land and water, most fogs visit us between April and September; winter being comparatively clear, except from occasional land-fogs brought on by the induction of tropic currents upon our colder climate. Of the average 50 fogs annually in the City of Halifax, 9 come in July; 8 in June; 5 each in May and August; 4 in October; 3 each in January, March, April, September and December, and 2 in February and November respectively.

Dews and hoar frosts are one and the same; though, strange to say, those who pretend to wisdom in such subjects will tell you that dew is followed by dry and hoar frost by wet weather. There is obviously no reason in this. The fact seems to be that when the atmosphere is near saturation, and the sky clear enough to keep the earth's surface cooler, by radiation, than the lowest atmospheric layer, and the night calm enough to prevent the removal of this incumbent atmosphere rapidly, or the mixing of different portions thereof of unequal temperature by wind, Dew is formed in the milder months. Exactly the same process is gone through when Hoar Frost is deposited from the same causes, but if the temperature on the ground be below the freezing point the deposit congeals. Should the lower air become cooler from any cause, then Precipitation is apt to follow both Dew and Hoar Frost as Rain or Snow; but a warmer air may absorb this moisture and keep the weather dry. About 25 per cent. of our Dews are recorded in September, when the earth and air differ most greatly in Heat. Annually an average of 75 nights witnesses this Phenomenon, as Dew; and 53—as Hoar Frost, December shewing the greater number of the latter; then February, January, March, November, April, October, May, in order.—September generally has one such deposit, but June very rarely; as during the last 10 years, I once noticed 2—viz: in 1875, and once 1 Hoar Frost in June, in 1874. In July and August I have never seen Hoar Frost in Nova Scotia, nor have authentic record thereof.

It will not be necessary to say much regarding Thunder and Lightning, which being of so startling and attractive a nature, are very familiar to all. The former is the report as the latter is the flash of an electrical discharge. These discharges may take place between clouds and the earth, or between two layers of cloud. The former case is most common and its effect most to be feared. The Thunder may be heard without any visible Lightning, but this is only owing to other masses of wind obstructing a view of the latter. Again, that which is commonly known as "Heat Lightning" had better be called "Reflected Lightning" as it is merely the reflection of some Lightning, itself

beyond our vision, upon the low lying strata just above the horizon; and has nothing more to do with *Heat* than has any other Lightning—which however is a good deal. Many meteorologists argue that the sudden heavy Rain showers accompanying this Phenomenon are the *cause* of the condition of the atmosphere which creates Thunder and Lightning, and not the *effect*, as was for so long believed. And this appears more reasonable, as the descent of large quantities of water must certainly disarrange the electrical state and change the relative position of the cloud strata; while it is hard to say why the display of Lightning should cause immediate rain. But as so many different agencies are at work on the Temperature, causing numerous ascending and descending currents, and divers excitements of electricity, the question becomes excessively intricate, and even yet is probably not thoroughly understood. It is a mistake to suppose that "Thunder clears the air" as is so often said. After such a storm fair weather may ensue, from outside and totally independent causes; but my experience has been that fog, or cold drizzling rain, much more frequently follows; as, upon consideration, is the condition most natural to expect with a suddenly lowered Temperature. The great heats of the tropics are more productive of Thunder and Lightning than the temperate air of this Latitude. In Nova Scotia the normal number yearly is 12—five-sixths of which occur in Summer, or between May and September.

Hail is another consequence of a disturbed electric state of the atmosphere, and is again more common in the hotter seasons. Indeed we never see it in Nova Scotia in winter, and very seldom at any time of the year. The combination of conditions necessary to produce Hail is very similar to that from which Thunder and Lightning originate. An upper stratum of air of very different Temperature from that below; and in this case the warmer being uppermost, and the lower very cold and a long distance above the Earth, the precipitation from the former freezes on its descent, and reaches us in fragments of ice, frequently of sharp-angled crystallized form. *Sleet* is often spoken of as *Hail*, but the two are very distinct and should not be con-

founded ; for while the one is as I have attempted to describe it just now, Sleet is merely snow thawing or Rain freezing as it approaches the earth's surface.

The Phenomenon of the Rainbow, although comparatively speaking not very frequent, is so striking and impressive, and at the same time so easily understood, that no particular description of its appearance, cause, and effect, is called for in these notes. Two, and even three, bows are sometimes observed : growing fainter by repeated reflection as they recede from the centre, till the colours of the outside arch of the three become very pale and indistinctly merged in the hues of the surrounding sky. The Rainbow is seen in showery weather, when there is much disturbance or mingling of air currents, so that a rather long term of unsettled cloud and electric conditions generally accompanies its appearance. This, and the well-known fact that the sun must not be very far from the horizon, so that its oblique rays may strike through the falling Rain-drops, are the only two points of practical importance in connection with this Phenomenon. The differences in effect ascribed to the Rainbow in the morning and in the evening are evidently not founded upon reason. An average of only five Rainbows annually takes place, and by far the larger number between May and October. Indeed during the past 10 years in Halifax, I have observed but three in winter, and those late in February, in March and April.

In Halifax the normal number of days of Sleighing is 70 ; almost always comprised between the beginning of December and the end of March. In 1872 I entered the largest number of days when runners were preferable to wheels in the city, viz: 98; and in 1870 the least, 45. Unless we have much snow in November and December of this year, however, 1878 is likely to show the most bare ground of any year of the last 20, as so far we have had only 28 days on which sleighs could be used—11 in January and 17 in February—none since the 26th of the latter month. The farther you go from the sea-water, as is natural, the longer the snow roads remain good, and in the interior of the Province of the five months between middle of November and middle of April, three are generally good for

sleighing. In November and April, however, the ground is rarely covered with snow for more than a few hours together. The earliest sleighing I have ever recorded was on the 1st day of December, 1857, and again on the same day of the year 1870—but I believe there has been an occasional day's sleighing in November in one or two earlier years. The latest of which I have any knowledge was on the 27th April, 1876—being thirteen later than the occurrence formerly, the last of which was in 1874. This audience will excuse me from dwelling so long and particularly on details which are not very important to us, and at the same time familiar ; but I hope, through the medium of this Institute, that I am speaking over a much wider field than is now before me ; and to those who instead of being well acquainted with the effects of Nova Scotian climate believe it to be Arctic in its winter frosts, and inhospitable to immigrants and agriculture during every season ; a misapprehension which cannot be too soon rectified, and which I sincerely trust these papers may have a tendency to correct, bringing forward as they do the indisputable testimony of observed facts.

I have been accustomed to believe that the Aurora Borealis was " not a purely magnetic Phenomenon," and on several occasions have publicly expressed such an opinion. But I confess to now thinking that I have been mistaken ; and the wonderful and intimate relation of Electric force to all Atmospheric convulsions has chiefly led to this change, while the evident disturbance of the magnetic needle during these displays quite overthrows the objection made to this theory, that the Auroral streamers were not only North and South, but often sprang from every quarter towards the zenith as the sustaining ribs of a mighty canopy arching the heavens. I have frequently noticed the sudden fall in Temperature accompanying the Auroral Phenomenon, and have brought before this Institute some remarkable instances of this fact, especially in a series of observations taken in 1869, when an average loss of Heat 2.2° per hour occurred during the period of visible Aurora. As high a loss as of nearly 3° degrees per hour for 9½ hours has been recorded at the time of display. The idea that the Aurora is a constant

forerunner of storms, or even of any quantity of Precipitation is erroneous. Of course it is an index of atmospheric disturbance to a greater or less extent, and the record is in accordance with the reasonable supposition that storms do occur within the wide area of observance of the Phenomenon ; but, as said, it by no means follows that because we see the Aurora Borealis at any one given point, a change of weather for the worse may be expected at the same point. In Halifax by my observations 44 per cent. of Aurora are succeeded by a continuance of fair weather. After the remaining 56 per cent. Rain or Snow has been measured the next day, but in only 36 instances out of the hundred has a Gale visited this locality. By thus expanding the ground of observation we can alone upset the narrow conclusions of isolated and casual notices. The seasons of the year when the most rapid and frequent variations take place are the most favorable to the appearance of this display. Consequently we count the greatest number of them in Spring and Autumn. In the year the average number to be seen is 26.—In the following months respectively : January 1, February 2, March 2, April 3, May 3, June 3, July 2, August 2, September 2, October 3, November 2, December 1. But there appears to be a rotation in the visibility of the appearance of the Aurora, as yet not sufficiently accounted for, and at present we must be at the farthest extremity of the term, and may soon look for its return. In all the last year 1877, I saw but five displays, and in the first four months of 1878—including April, the month of highest average of Aurora, only one visit of this Phenomenon have been observed.

In a paper brief as this I have necessarily omitted several of the minor appearances and optical illusions, sueh as the Paraselene, mock sun, Saint Elmo's fire, &c. ; and now pass on from the principal celestial and atmospheric Phenomena, to those periodic animal and vegetable recurrences which mark the progress of the seasons in this Province.

I have been favoured by Mr. Fitzgerald Cochran with " the " summary of the weather and seasons kept at Windsor, Nova " Scotia—being the average for 18 years, viz: 1794–1811—both " inclusive, by Rev. Dr. Cochran, Vice President, King's College."

This "Summary" (although the *instrumental* observations must be taken with caution, as the Barometers, Thermometers and Guages could hardly have attained the perfection of manufacture and position of the present day) is most interesting from the careful character of the observer, and its great age of 84 years. Another very interesting feature of the summary is its close agreement with the periodic events of the seasons of the last 18 years; disproving to a large extent the popular fallacy that the winters were longer and the springs later in bygone years than recently. Without recording all the events noted in Dr. Cochran's table, I refer to some of the leading occurrences. Thus between 1794 and 1811, the average date of the beginning of ploughing at Windsor was the 11th of April. Frogs began to croak 12th, and Gooseberry in leaf 23rd of same month. Swallows appeared 1st May (rather late.) The Plum, Cherry and Apple in flower 15th, 20th and 27th of May (all a little early.) The Lilac bloomed 1st (decidedly early), and the English Thorn or May 10th June. Mowing Grass began in Windsor 8th July—an early average for that locality, though close to the usual period of the more moist Atlantic coast. It is a pity this valuable table did not include the fruit bearing season of this Province, that farther comparisons might be made of the products, as well as of the blossoms of our country.

To come down to our own time, I find the averages of spring to be, as taken from a list compiled from my observations last year.

Daffodil, May 4th.
Cherry, May 21st, (a day later than above summary).
Lily of the Valley, May 28th.
Pear, May 28th.
Wild Cherry, May 31st.
Apple, June 3rd (a week later than above.)
Horse Chestnut, June 6th.
Lilac, June 9th (8 days behind the older record.)

The summer ripeness was of the

Strawberry, June 30th.
Pea, July 1st.

Cherry, July 7th.
Potato, July 8th.
Raspberry, July 21st.
Blueberry, July 30th.
Blackberry, August 14th.
Harvest Apple, August 20th.
Madeleine Pear, August 25th, and
Nectarine Plum, August 26th.

The Autumnal fruits averaged—

The Maria Pear, September 9th.
The Washington Plum, September 10th.
The Bonleritica Pear, September 28th.
The Green Gage Plum, September 13th.
The Capianman Pear, September 28th.
The Cycle Pear, the same date.
The Marie Louise Pear, September 29th.
The Flemish Beauty Pear, September 30th.
The Gravenstein Apple, October 1st.

Thus it will be readily noticed that at any rate the end of the eighteenth century and the middle of the nineteenth, do not vary materially from one another ; and it is fair to infer that the progress of vegetation, and therefore the temperature and other natural features of climate were much the same, at least, in the last century as in this.

I shall probably have to leave to others the more extended labor of deducing results from the facts which I have accumulated ; but this is evident, as I think that I have proved both by the paper read before this Institute last May, and by this its successor,—that the climate of Nova Scotia inland and seaboard, is more salubrious, more agreeable, and more capable of producing the fruits of a similar latitude in Europe, than is generally believed outside of the Province, or even by the inhabitants of this country themselves.

This proof, however, is only from a partial comparison of a portion of the middle term of this century, and the closing years of its immediate predecessor. More lengthened comparisons with accurate instruments are needed to bring out full results

The successive Governments of Canada have already done some good work in partly equipping a few stations, and enabling observers to some extent to tabulate their statistics. But the present neglect by Government of a Vital Registry has thrown back, and is losing many valuable periods of the discussion of Canadian longevity. The partial returns collected point to facts favourable especially to Nova Scotian length of human life. About 16 lbs. of ammonia per acre are annually deposited over the surface of this Province, generally from the great snow and rain precipitation on comparatively few days. In Great Britain from 6 to 9 lbs. is the annual allowance—and this on many days comparatively. Thus Halifax has 161 wet days and London 152—or nearly as many ; but in those days we receive about double of the life-giving salt, that falls over the latter city. Therefore, supposing the soil of this peninsula to be as highly cultivated as that around Kew (which, by the way, it is *not)*, it should be more productive, from atmospheric influence, and, cæteris paribus, human life here should be safer from functional disorder ; and consequently we should live longer.

Our wettest months—October, January, February, and November—(loosely speaking, the winter), are the most healthy. Except of course, among very old people, where the vital force is already so feeble that it cannot await the reaction from the lowered circulation. The same phenomenon becomes still more clear in Great Britain—that immense storehouse of our learning—where, if the world learns best how to destroy life, it also finds the most knowledge of its preservation, and alleviation of its miseries while lasting on this earth.