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Notes on the Geology of the Admiralty Group of the Thousand Islands, Ontario.

By Frank D. Adams, McGill University, Montreal.

The Thousand Islands, lying in the River St. Lawrence near its exit from Lake Ontario, and which are so well known as a summer resort, owe their origin to the passage across the river here of a narrow arm of the hard Laurentian rocks which form the great nucleus of the North American continent, which arm nearly connects the main part of the nucleus forming the Canadian Highlands with the outlying area of these rocks in the State of New York, known as the Adirondack Mountains.

The islands, some 1,400 in number, naturally fall into several groups, and that known as the Admiralty Group includes about 150 rocks and islands of various sizes, lying to the south-west of the town of Gananoque.

The Canadian islands, having recently been offered for sale by the Government, have been surveyed and their respective areas determined. The larger islands have retained their names on the Government map, while the smaller islands have been designated by numbers, corresponding numbers having been painted on some conspicuous object on the several islands, thus enabling them to be readily recognized.

A short general account of the geology of these islands was given some years since by Dr. A. P. Coleman,[1] in a paper which appeared in this magazine, and a more recent paper by Dr. C. H. Smythe, Jr.,[2] gives a more detailed description of the diabase dykes which cut the country rock. Some additional information, obtained during a recent visit to the islands, is presented in the present paper.

The prevailing rock is referred to by Dr. Coleman as a granite, but as it usually possesses a more or less distinct foliation it might perhaps be termed a granitoid gneiss. The foliation is, however, usually very indistinct and a true banded arrangement of the constituents was not observed in it. It is composed essentially of quartz and orthoclase with but small quantities of iron magnesia constituents, these consisting of biotite and hornblende. As a much more massive rock which may be classed as true granite occur and is quarried on several of the islands, *e.g.*, Forsyth, Juniper and Grindstone Islands, the relation of this to the granitoid gneiss just referred to is a matter of much interest as bearing upon the problem of the origin of the Laurentian gneisses, the question presenting itself as to whether the granite in question cuts this granitoid gneiss and is later than it, or whether the gneiss is produced from the granite by movements set up in it, either in a plastic or solid state.

The granitoid gneiss composing several of the islands, as, for example, No. 18, No. 16 and Campbell Island (Sagastoweka) often shows a granulated or augen gneiss structure. The granulated structure is well seen in rock

1 Some Laurentian Rocks of the Thousand Islands. Can. Rec. of Sci., Vol. V., No. 2, 1892.

2 A Group of Diabase Dykes among the Thousand Islands, St. Lawrence River. Trans. N.Y. Acad. Sci., Vol. XIII., Aug., 1894.

No. 16, which, on large weathered surfaces, exhibits an indistinct gneissic or streaked structure, due to the alternation of rude and ill-defined streaks or bands composed of a very fine-grained mixture of quartz and reddish orthoclase, with others holding a great number of small, irregularly shaped or angular fragments of a very dark-colored feldspar, apparently identical with that seen in the Jupiter Island granite to be mentioned later, and which are embedded in a similar fine-grained ground mass. Narrow strings of translucent quartz, evidently of secondary origin, also occur occasionally running in the same direction. The whole appearance conveys very strongly the idea that the structure of the mass has originated from movements in a softened mass of granite, the finer granulated portions having been produced by this movement and being most abundant where the movements have been greatest.

Of the granites above mentioned, that from Forsyth's Island is rather coarse in grain and although uniform in character and massive in general appearance, still frequently shows, when examined closely, a rather distinct parallel arrangement of the quartz in one direction. It consists of red orthoclase, whose cleavage faces can often be observed to be twisted, with bluish quartz, and a comparatively small proportion of iron magnesia constituents. Under the microscope a specimen of this granite, taken from the quarry near Mr. Forsyth's house, was found to possess the following characters :—

Orthoclase and microcline are abundant, and are often somewhat turbid from the presence of decomposition products, while the lime soda feldspars are represented by a few grains of plagioclase. The quartz, though less abundant than the orthoclase, is present in large amount and shows intense strain shadows. Every grain is twisted or divided up into subordinate areas, ill-defined against one another, but marking the tendency of the individual to break or move along the lines bounding them. The mineral, however, although much distorted, as in all similar rocks, does not show more than traces of actual granulation under the pressure to which it has been subjected, and this only in a few places about the immediate periphery of the grains. Approximately equal amounts of green hornblende and highly pleochroic brown biotite are present, the former largely altered to chlorite and carbonates, and the latter in places decomposed to chlorite. Both of these minerals, however, are present in but small amount. A few grains of sphene and zircon are also present. The rock has evidently been submitted to intense pressure.

The granite on Juniper Island has been extensively quarried. The surface, where stripped for quarrying, is seen to be beautifully smoothed and grooved by the action of the ice, but where it has not been protected by the soil covering, it is considerably weathered and these evidences of glacial action are not so well displayed. The rock is excellently exposed on the face of the quarry. It is dark in color, owing to the dark color of the feldspar rather than from the presence of bisilicates or mica, which are not abundant. It does not show a gneissic structure, but on the glaceated surfaces is seen to be somewhat uneven in character, owing chiefly to the irregular distribution through the rock of rather large and more or less irregular shaped and apparently broken feldspars which are dark in color, while the rest of the feldspar which constitutes the greater part of the rock is red in colour and is apparently in a granulated condition. In places there is also, for a foot or two, a tendency to parallelism among the iron magnesia constituents, a structure which would seem to have resulted rather from primary movements in a highly heated rock than from secondary crushing after the rock had cooled. The structure resembles that described above as occurring in the granitoid gneiss, and, although much less distinct, is suggestive of the derivation of the latter from a similar granitic rock by movements set up in it. Numerous long and narrow patches of very coarsely crystalline granite or pegmatite are also present in the rock. These are composed of quartz, potash feldspar, black mica and schorl, with occasionally a small amount of a yellowish green mineral having the blowpipe characters of scapolite, a mineral which would hardly be expected among such surroundings.

Dr. Coleman also mentions the occurrence of a true gneiss as well as of quartzite on this group of islands. These were observed by me on the two islands known as Aubrey and Lemon Islands, where they were cut by the granite.

Of considerable importance also as serving to correlate these rocks with the Laurentian on the mainland of Ontario and in the Adirondacks, was the discovery of a large exposure of white crystalline limestone which I found on Island No. 18, and which resembles in all respects that of the Grenville Series. It occurs crossing the south-west corner of the island, being exposed for a distance of twenty-five yards along one shore, and for about ten yards on the other side of the island where it is seen beneath the surface of the water. The rest of the island is composed of gneiss, except that portion occupied by a diabase dyke which is exposed for a width of fifteen yards, traversing the island at its south-west corner and being bounded by the crystalline limestone on one side and by the gneiss on the other.

At the west end of Island No. 21, also, slabs of coarsely crystalline limestone were found lying upon the beach. Although this rock was not observed in place, the shape of the fragments indicate its occurrence in the immediate vicinity. The island itself is composed of a white weathering gneissic rock with no iron magnesia constituents, and possessing a structure resembling somewhat that of a fine-grained pegmatite.

No other occurrences of crystalline limestone were observed.

The dykes described by Dr. Smythe are well exposed on many of the islands, as, for instance, on Lemon, Little John, and No. 14. One long dyke starting from Bluff Island can be observed crossing No. 19, which is made up almost entirely of it, and No. 18 to No. 16, where it seems to terminate. There are, however, probably about thirty of these dykes in all, having a general north and south course and a nearly vertical attitude. Taken together they would be equivalent to a sheet of diabase about 300 feet thick. Some of these dykes consist of ordinary diabase and some of olivine diabase. The fact that they are finer in grain toward the sides proves that the gneisses and granites, through which they cut, were cool at the time of their intrusion. They do not cut the Potsdam Sandstone, and are, therefore, older than the Upper Cambrian, while, as Dr. Smythe observes, the absence of any considerable evidences of dynamo-metamorphism in them demonstrates that, during the great length of time which has elapsed since the intrusion of the dykes, the region has not been affected to any great extent by mountain-making forces.

Modern Attainments in Geology.

A Lecture Delivered Before the Natural History Society of Görlitz, by Prof. Edward Suess, of Berlin.

Translated for The Canadian Record of Science by Nevil Norton Evans, M.A.Sc.

Ladies and Gentlemen:

I am to address you upon modern attainments in geology, that is, I am to conduct you to the limits of our science, as only there, where our outposts are, can we see in what direction further advance is being made. Whether I shall be successful, I do not know; but the subject is such a comprehensive one that I must not permit myself a longer introduction.

Let us first glance at the road already trodden. One may say that the geology of to-day started at the great Mining School of Freiberg in the last century. There it was, under the lead of Werner, that deep study was given to the manner in which different rocks were deposited, and where continuous districts were systematically investigated. But not till Cuvier had pointed out in the first decade of this century that the remains of mammals found in the gypsum of Paris really belonged to extinct species; not till the Englishman Smith showed that in the different layers of stratified rocks different fossils occurred and that hence it was possible to classify these strata according to the fossils contained in them; not till Leopold von Buch had given a tremendous impulse to the investigation of the structure of mountains, could one recognize what an extraordinarily wide new field was opened to human investigation.

Further great advances were made in the first half and the middle of the present century. In Freiberg geology was originally studied for the purpose of tracing ores of the noble metals which occurred there in the form of veins. Later it was found that coal and iron possessed a much greater value for a state, and finally people were convinced that a much more insignificant portion of our earth—the soil—was of supreme importance for the well-being of a country.

Thus we have gradually come to the conclusion that the investigation of the geological structure of a country is an important preliminary to the advancement of its agricultural development; and it has therefore come about that not only the countries of Europe, but many countries outside Europe, have conducted or introduced such a study of their lands at the public expense. Not only the United States, but also Canada, Australia, New Zealand, Japan possess such institutions. Where such departments are wanting, enterprising travellers have extended our knowledge; chief of these, Ferdinand von Richthofen in his comprehensive work on China. The English and Russians have explored the high mountains of Central Asia, and one may say that at the present time we possess at least some knowledge of the geological structure of by far the largest part of the surface of the earth.

The government undertakings just referred to generally suffer, however, from the fact that their work leaves off at political boundaries. These political boundaries by no means correspond to natural divisions; frequently they follow a watershed and one side of the mountain range belongs to one country and the other to a neighboring land. So it is, for instance, with the Giant Mountains (Riesengebirge) through which I travelled to-day. Only when the public surveys of the different countries are united, is a correct picture of the real significance of certain details in the structure of the surface of the earth obtained. The picture of such things which we to-day possess is, therefore, not due to the labors of individuals, but is the product of a mass of concerted work.

A special and important branch of geology consists of the studies regarding the origin of the present surface relief. For a very long time every system of mountains was considered as having been formed by the upheaval of a linear zone of the crust of the earth, the so-called axis of the system, the lateral ranges being disposed on either side of this axis and symmetrical to it. The upheaval of the central axis was regarded as having been caused in much the same way as volcanoes were presumed to have been formed. A force, acting from within the earth, was supposed to have elevated the axis of the system, pushing aside the secondary ranges. Thus it was that Leopold von Buch pictured the operation to himself.

Others, in particular the great French geologist Élie de Beaumont, considered it possible that a simple geometrical law could be formulated to account for the arrangement of mountain axes on the surface of the planet. It was supposed that these axes corresponded to the edges of a crystal inscribed in the sphere of the earth.

All these older views which for years formed a fruitful basis for research are, however, no longer in accordance with the knowledge of to-day. Their most important suppositions are now known to be very doubtful. In the first place it has been shown that the structure of the largest mountain systems is not symmetrical, but unsymmetrical and one-sided, and that approach to a symmetrical structure occurs only very exceptionally. Thus, for instance, the mightiest of the so-called "central stocks" of the western Alps, Monte Rosa, does not lie at the centre of the system, but almost on its southern edge.

The idea of Élie de Beaumont, according to which the mountain ranges correspond to the projections of the edges of a crystal on the surface of the earth, is for one reason alone no longer tenable: the great mountain chains, with few exceptions, do not run in straight lines, but take a more or less curved course.

In order to arrive at a correct understanding, it must be remembered that the form of the earth's surface is materially affected by the destructive influence of frost, weathering, and running water. What we see before us as mountains are the more or less demolished ruins of the much mightier heights which Nature first built. If one has learnt to roughly reproduce in his imagination the original form of these ruins, an entirely different and much more magnificent picture is obtained. It is very different from the picture of the landscape painter or the map-maker. But only in this way can a basis be obtained from which it is possible to decide upon the causes of the formation of mountains.

The force concerned in this work seems to be principally a contraction of the outer crust of the earth, connected with a shortening of the diameter caused by the gradual cooling of our planet.

We observe two phenomena through which the contraction is evident: either horizontal movement—that is, folding; or vertical contraction—that is, subsidence.

According to the predominance of one or other of these two movements, we see the surface of the earth laid out in long folds, as in the Alps and the Ural; or we have flat table-lands, as in the Sahara and Central Russia, or lines of subsidence, as in the Dead Sea, or whole regions depressed, as on the western side of the Apennines.

The folds of the mountain ranges run in long lines forming curves and often abut against older fragments by which they are turned aside from their course. They bend like the waves on a disturbed surface of water, and the outer folds which form the edge of the range are sometimes completely overturned, so that along these edges the strata of the folded rocks are met with in reversed order. Thus parts of the surface of the earth appear here as table-lands, there as areas of depression, and in still other places as folded and overturned portions of the crust, in which, as already stated, the more recent foldings have been restricted in their development by the already existing structure of the country.

From this it is, however, seen that the relief of the earth's surface does not by any means always correspond with the deeper structure. Therefore, in order to obtain a correct understanding of the facts, the structure, that is, the lines of folding or the lines of fault, must be kept in view. These lines are the determinants, not the relief.

Take, for instance, the Hartz. According to contour, this mountain system has the longer axis of its ellipse running north-north-west; it consists, however, of folds which strike north-north-east, directly across the relief. If the relief only were considered, the Hartz, with the contour above mentioned, appears as an independent mountain system, and thus it is considered by geographers; the geologist, however, who follows the strike of the strata, sees in it only a continuation of the Rhenish mountains lying to the west, in which the same direction of folding predominates.

The same thing is observed in the Vogesen (Vosges Mountains) and the Black Forest; the direction of the strata is north-north-east, straight across the general direction of the ranges, and finds its continuation on one side in the central plateau of France, and on the other in the Fichtel Mountains. In this way a correct picture of the actual relations of things is obtained, and one is thereby easily convinced that these pieces of mountain ranges, now disconnected, are in reality the remnants of a uniform system of folds, of which large parts have subsided and disappeared. Between the portions which have thus been depressed, the remaining parts stand up, as the Black Forest and the Vogesen, and these elevated parts we call Horsts.

As has already been stated, there was a time when it was thought that the mountain chains of the earth were arranged according to certain geometrical systems, and it was believed that in them the edges of certain crystal forms inscribed in the sphere were to be seen. But the further our knowledge reaches, the further away this idea of any supposed geometrical regularity retreats, and, as is so often the case in nature, we arrive at something entirely unexpected.

If the main lines of the great folded areas, known to us in their entirety or divided up by subsidences into horsts, be laid down on a map, immense wavy curves are generally obtained, and in these curves a convex outer side, frequently with overthrust folds, and a concave inner side, often conspicuous for frequency of subsidences, may be distinguished.

If that part of the earth which is called the "Old World" be studied from this point of view, that is, by searching out the main lines of folding and, when they are fragmentary, reconstructing them in their entirety from the fragments, the general results may be summed up as follows:—

The first system of folding begins at Genoa, runs through the Apennines, through Sicily, Northern Atlas, bends at Gibraltar directly across the Straits, continues through the Cordilleras of Southern Spain and the Sierra Nevadas, and reaches to the Balearic Islands. This great curve we shall call the curve of the Western Mediterranean.

The second curve forms the other side of the Adriatic. It includes Dalmatia, Albania, Greece, stretches then through the Islands of Crete and Cyprus, and finds its continuation in the Taurus. This is the Dinarian-Taurus curve.

The third curve runs along the course of the river Tigris, includes the Zagros chain, stretches along the east coast of the Persian Gulf and then west of the Indus towards the north to within the district north-west of the city of Dera Ismail Khan. This curve includes the whole of the Iranian highlands, and is, therefore, called the Iranian curve.

The fourth curve is short and reaches from Dera Ismail Khan to the river Jhelum. This piece forms the outer boundary of the great Hindoo Koosh mountain system, and this edge is in a remarkably violent way disturbed and overthrust. The edge is called the Salt Range.

The fifth curve is formed by the Himalayas. On the outer edge of these high mountains also the strata lie completely reversed, the older above the more recent. It stretches south-south-east to the point where the Brahmaputra leaves the mountains.

Against this abuts with sharp boundary the greatest of these curves, which we shall call the Burmese. It runs, defined by the course of the Irawady, in an almost meridional direction from Central Asia, and its outer edge runs from Cape Negrais, through the Andaman and the Nicobar Islands, Sumatra and Java, to the Sunda Islands.

A large number of more or less parallel or concentric systems of folds occur in Central Asia along the outer edges of the Burmese curve, the Himalayas, and the Salt Range, and these mighty chains stretched one behind the other, forming the highlands of inner Asia, appear, as far as is known to-day, to be without exception folded to the south, exactly as the curves just mentioned. These southwardly folded chains of inner Asia terminate towards the Pacific Ocean in separate arc-like ends, and in this way form along the east coast of Asia those curious curved series of islands which have frequently been compared to flower garlands.

The first of these arcs is formed by the Loo-choo Islands, the second by Japan, in which in the centre of the island of Hon-Schiu a great cross disturbance or meeting of two curves occurs. The third arc is formed by the Kuriles which run from Yesso to Kamtschatka; Kamtschatka consists partly of a continuation of the Kuriles and partly of a second inner arc. With these arcs, standing in such intimate connection with the east of Asia, is connected as a broader, larger curve the series of the Aleutians and the peninsula of Alaska.

All these curves, beginning with the bend at Gibraltar, that is with the portion lying in Spain, I say all these curves from Gibraltar to Kamtschatka and the Aleutian Islands are distinguished by being folded towards the south. They produce with one another a curiously formed but very sharp boundary against the table-lands, to the north of which they lie. To these table-lands belong all Africa south of the Atlas, Arabia with Palestine and Syria, and the peninsula of East India. The high Drakenberg Mountains of the colony of Natal or the Ghats on the western edge of the Indian Plateau are not true mountains but broken-off table-lands, and when one has ascended them, a more or less flat high table-land is seen.

In this way the old world is divided for us into two parts, the boundaries of which do not coincide with the present divisions of the world. We call all land north of the outer edges of the boundary curves above named, Eurasia, and the table-lands lying to the south are indicated by the word Indo-Africa. Indo-Africa, therefore, extends from the mouth of the Wadi Draha on the Atlantic to the mouth of the Brahmaputra on the Bay of Bengal.

Let us glance for a moment at the other parts of the earth's surface. Both North and South America exhibit the remarkable phenomenon of being in the main folded towards the west, that is towards the Pacific Ocean. At Williams Sound, south of the peninsula of Kenai, there succeed to the arc of the Aleutians the series of the *Western system of North American folds*, which are continued in Lower California and Mexico. South of the Gulf of Tehuantepec the conditions change and relations appear which exhibit a certain similarity to the curve of the Western Mediterranean. The following is observed :—

In the north of Venezuela series of folds occur which run from east to west and which reach their clearest expression in the contour of the Island of Trinidad. It seems that these folds find their continuation in Tobago and the Lesser Antilles. With approximate certainty one follows through the Lesser Antilles the trace of a mountain system which comes over from the Virgin

Islands to Porto Rico, and in San Domingo splits into two parts. One part finds its continuation in Jamaica and the other in Southern Cuba.

A further curve forms the whole northern part of Cuba, and in Guatemala and Honduras this same series of folds is seen running directly across the contour of Central America from the region of the Caribbean Sea to the Pacific Ocean. In this region, therefore, the direction of the folds runs directly across the contour of the land. It cannot be seen how the series of folds in Honduras are continued, and the Galapagos consist only of volcanic rocks. It may, however, easily be observed that rocks similar to those forming the curve of the Antilles just mentioned occur in Venezuela, and thence form three systems, reaching out toward Ecuador, and finally re-uniting into one, and from there form a single mighty series of folds, giving rise to the high Cordilleras of the Andes, among which the great volcanoes occur like foreign bodies.

A new curve begins at the Bay of Arica, which traces the west coast of Bolivia, runs through Chili and Western Patagonia, and finally bends round Cape Horn and reaches Staten Island with east-and-west strike. All these series of folds are turned to the west with the exception of the above-mentioned distorted curve in the Antilles and the southern portion in Staten Island.

Australia exhibits predominantly eastwardly folding. The westerly part of the Australian continent corresponds to a table-land of similar formation to that of Indo-Africa and is possibly a continuation of it. The eastern edge is bounded by a long series of folds which are continued into Van Diemen's Land. New Zealand and New Caledonia are portions of outlying folds which are to Australia what the mountain ranges of the Salt Range or the Himalayas are to the part of inner Asia farther north.

Let us now return to that part of the earth which we know most accurately, namely, to Europe, or, as we should more exactly call it, to Western Eurasia. The phenomena are here peculiarly complicated, indeed they seem to reach a higher degree of complexity than anywhere else in the world. Whereas all the bounding curves of Eurasia already mentioned are folded towards the south and as also through the whole of Central Asia the southerly direction of folding predominates, the systems of folding in mid-Europe are directed to the north, and, moreover, Europe has been folded over and over again and always towards the north.[1]

Let us begin in the north-west. Iceland, like Jan Mayen, is of volcanic origin. The Western Hebrides, all Norway, the Lofotens to Magerö, and up to the North Cape consist of primeval gneiss. If one passes over, however, from the islands to North-Western Scotland, rocks are immediately encountered which are completely overturned, which have been thrust up on to the old gneiss area in reversed order, and which form the outer edge of a great series of folds. The general strike of these folds is towards the north-east. The series includes a great part of Ireland and Wales and portions of England, all Scotland, and finds its continuation in the western folds of Norway. This was once a uniformly folded highland, of which we see to-day only remnants, and among these remnants flows the sea. This we call the Caledonian System.

This system of folds is of very great age, and for those who have made a closer study of geology we would add, that in them the Silurian rocks are folded, while the lower Devonian deposits lie horizontally. The age of the Caledonian folds is therefore greater than that of the Devonian deposits.

On the west coast of Ireland, south of the mouth of

[1] See "Geological Structure of Europe," Suess, with map, in last number of RECORD.—Trans.

the river Shannon, we again meet with the overthrust edge of a series of folds. This overthrust edge stretches directly across the southern part of Ireland, reaches Wales at St. Bride's Bay, and passes straight across the southern peninsula of Wales, through the coal fields of Glamorgan, directly across the Bristol Channel to the Mendip Hills, then, covered by more recent sediments, across the south of England to Calais and the district of Douai and Valenciennes in the vicinity of the boundary between France and Belgium. The overthrust is here very well known, because just on this line in France are important deposits of coal; they are all more or less inverted. The strike of this outer edge and the corresponding folding is in an easy curve from west-north-west to east-south-east.

Everything lying to the south of this line, that is Kerry and Cork, Cornwall and Devon, Normandy and Brittany, as far as Vendée, is made up of folds of the same direction of strike; they were all folded towards the north and later broken down, that is, divided up into horsts. It may also be here remarked that the geological age of this system of folds is known and that it is less than that of the Caledonian. The time of principal folding falls in the later part of the Carboniferous age, because the older members of the coal formation have been concerned in the folding, while the younger members overlap the already denuded folds. We therefore designate the age of this folding as intercarboniferous. The highest mountains of this system seem, as far as we can judge from the remaining fragments, to have been in Brittany, perhaps in Morbihan; and as the peninsula of Brittany was called by the Romans Armorica, we call this system of folds the outer edge of which, as already stated, ran from the Shannon to the Franco-Belgian boundary, the Armorican folds or the Armorican mountain system.

Beginning at the point just mentioned, between Douai and Valenciennes, the direction of the folds changes; they now strike east-north-east. Here again we have to do with a completely overturned and overthrust outer edge, the nature of which may be exactly determined from the structure of the Belgian coal measures. The group of folded horsts, with which we must now deal, is particularly large. The overthrust outer edge is not visible at many places; it is seen, as already stated, in the Belgian coal measures; on the other side the Rhine it disappears and is not again visible till it crops up again far east on the eastern bank of the Sudeten, in the overthrust of the western part of the coal measures of Ostrau.

The horsts of these fragmentary mountains exhibit folds which strike in the west towards the north-east or north-north-east, and further along towards the east, then towards the east-south-east, south-east, and finally towards the south. They thus form a great curve convex towards the north, and the most important horsts are as follows:—First, in the Belgian coal fields, the whole system of folds on the Rhine and as far as the Taunus, further south the Black Forest, the Vogesen (Vosges) and the eastern part of the central plateau of France, then in the east the Hartz, and the series of mountain fragments more or less intimately connected with the Bohemian mass, stretching from the Thuringian Forest to the above mentioned coal fields at Ostrau.

The convexity of this curve is most clearly seen in the relations of the Ore Mountains (Erzgebirge) to the Giant Mountains (Riesengebirge.) In the vicinity of Hof in Bavaria there crops out the Münchberg gneiss, the base of the completely levelled ruins of a particularly important mountain, which was at one time perhaps the highest of this mighty system of folds, and since this country, the Saxon Vogtland, used to be called at one time the land of the Variscians, the name Variscian folds or Variscian Highlands has been selected for the whole curve from the central French plateau to the Sudeten. Nothing but the following up of the structure of the horsts has made it possible to recognize in the present fragmentary relief the unity of the old German mountain system.

The age of the Variscian range is exactly the same as that of the Armorican, that is, the principal epoch of folding belongs to the later Carboniferous.

Proceeding further to the south we easily see that the Alps and the Carpathians are nothing else than a third system of similar curves. With overturned outer edges the folds of the Alps stretch from the Durance through Switzerland, Bavaria and Austria. Their development towards the north has been sharply hemmed in by opposing horsts, the remnants of the Variscian curve. So, for instance, the folds of the Alps abut against the broken-off eastern edge of the central plateau of France, which rises in the neighborhood of Lyons, then against a small gneiss cliff which rises near Dôle in the neighborhood of Besançon, further against the southern edge of the Black Forest, and as soon as they have passed the southern end of the Bohemian mass, they turn towards the north, being no longer hemmed in, forming the great curve of the Carpathians. This system is called the Alpine System of folds. It is much younger than the preceding ones, and the principal epoch of its folding lies in Tertiary times. The folds are continued westwards; towards the north overthrust strata are met with all through Southern France as far as the Pyrenees. And the Pyrenees lie south of Armorica in a way similar to that of the Alps within the Variscian folds.

If we now consider the main features of this picture, the whole middle and north of Europe is seen to consist of a series of folds or scales of the crust of the earth thrust one over the other towards the north in such a way that the northern folds are the oldest, that they were broken down, that this process of degradation was succeeded by new foldings from the south, and that each time the new folds abutted against or were hemmed in by the horsts, that is, the projecting remains of the preceding folds.

The systems of folds, or scales, into which Europe may be divided are therefore :—

1. The Caledonian system, inside the gneisses of the Hebrides and Lofotens;

2. The Armorican and Variscian curves;

3. The curve of the Pyrenees and that of the Alps and Carpathians. What the relations of these are to the systems of folds immediately following and directed towards the south, namely, those of the Western Mediterranean and the Dinarian-Taurian curves, which, indeed, form only a continuation of the great series of the Eurasian limit curve, we are to-day not in a position to give any information.

We see how in this way our conceptions with regard to the surface of the earth gradually change. Lines which formerly had almost no significance seem to us now of great importance. In many cases the relief gives us a true picture of the structure, in others we must entirely ignore the relief. To-day the Alps rise to the greatest heights in Europe and present to us all their charms of landscape, but there can be almost no doubt that from the whole structure of the folds there once lay to the north of them on the Armorican and Variscian series of folds eminences of equal importance, and in a still earlier time similar heights probably existed in the Caledonian region. Now we distinguish table-land and folded-land more sharply from one another, and we learn to recognize the significance of subsided areas. The most striking of these are the oceanic depths, and although time will not allow me to go into details with regard to their formation and their probable origin, the following facts may be presented :—

In the first place, one sees that where the Indo-European boundary curves meet the ocean, *i.e.* (with the exception of the Persian Gulf) at the mouth of the Brahmaputra and from there on all along the east coast of Asia and the whole west coast of North and South America, with the single exception of the coast of Guatemala and Honduras, that is, from the Brahmaputra to Cape Horn, all along this coast the direction of the folds is towards the ocean. The Pacific Ocean particularly is almost entirely encircled by folds which run parallel to its coast line. From Cape Horn eastwards to the Brahmaputra, that is, in the Atlantic area and in the area of the western half of the Indian Ocean, the opposite is observed. Either we have table-lands which break off at the sea, like the Drakenberg Mountains in South-east Africa or the Ghats of India, or on the other hand mountain ranges break off at the coast, as was, for instance, the case in the Armorican horst, and only very exceptionally, as in the case of the Antilles and Gibraltar do curves run out into the sea.

The first type of ocean edge in which the shore is parallel to the folds is called the Pacific type; the second type in which there is no such conformity between shore and folding is called the Atlantic type.

We can go still further.

The distribution of stratified deposits permits of our saying, with a high degree of probability, that the Pacific Ocean, taken as a whole, is older than the other oceans, and that at one time a branch of it stretched directly across Indo-Africa to the locality where to-day exist the highest mountains—the Alps. Younger than the Pacific Ocean is the Indian Ocean as a whole, and the middle of the Atlantic Ocean, still considered only in a most general way, must be looked upon as the youngest of these three ocean areas. You see, ladies and gentlemen, to what great conceptions the unifying of the individual investigations carried on in the various countries of the world have led, and how questions and difficulties which were not known ten years ago rise before us. They have attracted in recent times the attention of many investigators. The finding of solutions for them, the amplifying of these solutions and the proving them correct is a great and attractive problem, and it is very probable that in following this line of study further many important views with regard to the formation of our planet will be brought forth.

Of course, potent activity prevails in other directions. In particular, I must not forget to allude to those studies which have arisen from the comparison of meteorites with the peculiarities of our world and which have led to the most surprising results with regard to the probable nature of the interior of our planet. In fact it may be said that most probably iron and magnesium form the principal part.

I must, however, deny myself the pleasure of going further into this subject.

From all these observations, as from all searching study of nature, many general points of view and connections of ideas arise.

The botanist who, in a quiet place observes the drooping branches of the weeping willow, sees in the beautiful tree a product of the art of gardening of ancient days, known only in pistillate individuals, and propagated only by shoots. If to the same student of nature genuine Muskatel be presented at the festive board, he knows that the Muskatel vine is known only in pistillate individuals, and an unsuspected chain of thought leads from the gay company to the quiet abode of the weeping willow, a change of thought quite foreign to his neighbor at the table.

On the map of the world, the geologist sees in Cook Strait, which separates the two islands of New Zealand, the crossing of a line of folding and his eye finds a repetition of the same in Matotchkin Strait in Nova Zembla. He sees in the Gulf of Pegu (Siam) a longitudinal subsidence of the middle part of such a series of folds, and he knows that the city of Vienna is built upon a like smaller depression similar in all its principal characteristics. If he travels from Bohemia to Görlitz, he recognizes in the Giant Mountains a fragment of the great Variscian curve which once stretched to beyond Lyons.

Here also a fresh network of ideas is woven. But this is not the final aim of a great science.

Two things, said Immanuel Kant, above all others, excited his wonder—the starry heavens and the depths of the human mind.

The child is delighted with the many little lights in the skies of night and gazes uncomprehendingly into the immeasurable depths of the universe. Science teaches us the motions of the stars; it teaches how small is our earth and how small we ourselves are; the boldest fancy shrinks before the sublime reality.

The human mind—each of us guesses its immeasurable depths, but only a few are capable of fathoming these depths, a few to whom earnest studies have granted a true insight into its phenomena. They know more of the inner man than we, we who speak wonderingly of it as a child of the starry heavens. Thrice enviable, however, are those chosen ones to whom it is granted not only to see but to minister to the mind diseased, and who are accompanied to their lives' end by the thanks of saved souls.

A third wonder is proffered us by geology. Beside the microcosm of man, and the macrocosm in the expanses of the firmament, there is opened to you the unlimited horizon of time.

The thousands of years of human tradition vanish as moments. How long frost and rain have gnawed at the mighty Alps, we do not know. How long it is since these mountains were formed, how long before the Alps the Variscian curve was built, how long before this the Caledonian curve, how long before this the gneisses of the Hebrides were folded and rumpled up, no man can say. When, in each of these cases, the foldings and when the great subsidences occurred, when the crust of the earth first solidified around the core of iron, we know not. The distances of the fixed stars, with but few exceptions, we are ignorant of, and here also we lack every measure and comparison.

He who gives himself to such reflections is lifted into a sphere in which not only human measures disappear, but the little human individual too, and he feels himself at the same time melt away like a cloud of mist before the sun, *because he is no longer concerned with earthly but* with cosmic quantities. Thus we reach not only the limits of our knowledge, the limits of our imagination, but the limits of our faculty of comprehension.

He who returns from such studies to the plane of commonplace daily life is strengthened as one who descends from mountain heights.

I dare not hope, in such a short address, to have awakened in you similar feelings, but will you not at least carry away with you, in opposition to the sickly pessimism which here and there is preached, the remembrance that in our day mankind has risen to views regarding the essence of natural phenomena, which are grander than the race has ever possessed in times past, and that although nations stand armed against nations, there are, nevertheless, in all cultured peoples men who, high above these variances, strive together with the investigators of all peoples of the earth untiringly and without envy, as brothers, towards a truer conception of the facts and laws of Nature.

Some Common Birds in their Relation to Agriculture.[1]

By F. E. L. Beal, B.S.

Introduction.

It has long been known that birds play an important part in relation to agriculture, but there seems to be a tendency to dwell on the harm they do rather than on the good. Whether a bird is injurious or beneficial depends almost entirely upon what it eats, and in the case of species which are unusually abundant or which depend in part upon the farmer's crops for subsistence the character of the food often becomes a very practical question. If crows or blackbirds are seen in numbers about cornfields, or if woodpeckers are noticed at work in an orchard, it is perhaps not surprising that they are accused of doing harm. Careful investigation, however, often shows that they are actually destroying noxious insects, and also that even those which do harm at one season may compensate for it by eating noxious species at another. Insects are eaten at all times by the majority of land birds, and during the breeding season most kinds subsist largely and rear their young exclusively on this food. When insects are unusually plentiful, they are eaten by many birds which ordinarily do not touch them. Even birds of prey resort to this diet, and when insects are more easily obtained than other fare, the smaller hawks and owls live on them almost entirely. This was well illustrated during the recent plague of Rocky Mountain locusts in the Western States, when it was found that locusts were eaten by nearly every bird in the region, and that they formed almost the entire food of a large majority of the species.

[1] Reprinted from Farmers' Bulletin No. 54, U.S. Department of Agriculture, 1897.

Within certain limits, birds feed upon the kind of food that is most accessible. Thus, as a rule, insectivorous birds eat the insects that are most easily obtained, provided they do not have some peculiarly disagreeable property. It is not probable that a bird habitually passes by one kind of insect to look for another which is more appetizing, and there seems little evidence in support of the theory that the selection of food is restricted to any particular species of insect, for it is evident that a bird eats those which by its own method of seeking are most easily obtained. Thus, a ground-feeding bird eats those it finds among the dead leaves and grass ; a flycatcher, watching for its prey from some vantage point, captures entirely different kinds; and the woodpecker and warbler, in the tree tops, select still others. It is thus apparent that a bird's diet is likely to be quite varied, and to differ at different seasons of the year.

In investigating the food habits of birds, field observation can be relied on only to a limited extent, for it is not always easy to determine what a bird really eats by watching it. In order to be positive on this point, it is necessary to examine the stomach contents. When birds are suspected of doing injury to field crops or fruit trees, a few individuals should be shot and their stomachs examined. This will show unmistakably whether or not the birds are guilty.

In response to a general demand for definite information regarding the food habits of our native birds, the Biological Survey of the Department of Agriculture has for some years past been conducting a systematic investigation of the food of species which are believed to be of economic importance. Thousands of birds' stomachs have been carefully examined in the laboratory, and all the available data respecting the food brought together. The results of the investigations relating to birds of prey, based on an examination of nearly 3,000 stomachs, were published in 1893, in a special bulletin entitled The Hawks and Owls of the United States. Many other species have been similarly studied and the results published, either in special bulletins or as articles in the yearbooks. The present bulletin contains brief abstracts of the results of food studies of about 30 grain and insect eating birds belonging to 10 different families.[1]

These species comprise among others the crow blackbirds and ricebirds, against which serious complaints have been made on account of the damage they do to corn, wheat, rice, and other crops; and also the cuckoos, grosbeaks, and thrashers, which are generally admitted to be beneficial, but whose true value as insect destroyers has not been fully appreciated. The practical value of birds in controlling insect pests should be more generally recognized. It may be an easy matter to exterminate the birds in an orchard or grain field, but it is an extremely difficult one to control the insect pests. It is certain, too, that the value of our native sparrows as weed destroyers is not appreciated. Weed seed forms an important item of the winter food of many of these birds, and it is impossible to estimate the immense numbers of noxious weeds which are thus annually destroyed.

If birds are protected and encouraged to nest about the farm and garden, they will do their share in destroying noxious insects and weeds, and a few hours spent in putting up boxes for bluebirds, martins and wrens will prove a good investment. Birds are protected by law in many States, but it remains for the agriculturists to see that the laws are faithfully observed.

[1] The limits of this bulletin preclude giving more than a very brief statement regarding the food of each bird, but more detailed accounts of some of the species will be found in the following reports of the Biological Survey (formerly Division of Ornithology and Mammalogy): The Crow—Bulletin No. 6, 1895, pp. 1-98; Woodpeckers—Bulletin No. 7, 1895, pp. 1-39; Kingbird—Annual Report Secretary of Agriculture, for 1893, pp. 233-234; Baltimore Oriole—Yearbook United States Department of Agriculture for 1895, pp. 426-430; Grackles—Yearbook for 1894, pp. 233-248; Meadowlark—Yearbook for 1895, pp. 420-426; Cedarbird—Annual Report Secretary of Agriculture, for 1892, pp. 197-200; Catbird, Brown Thrasher, and Wren—Yearbook for 1895, pp. 405-418.

THE CUCKOOS.

(*Coccyzus americanus* and *C. erythrophthalmus.*)

Two species of cuckoos, the yellow-billed and the black-billed, are common in the United States east of the Plains, and a subspecies of the yellow-billed extends westward to the Pacific. While the two species are quite distinct, they do not differ greatly in food habits, and their economic status is practically the same.

An examination of 37 stomachs has shown that these cuckoos are much given to eating caterpillars, and, unlike most birds, do not reject those covered with hair. In fact, cuckoos eat so many hairy caterpillars that the hairs pierce the inner lining of the stomach and remain there, so that when the stomach is opened and turned inside out, it appears to be lined with a thin coating of fur.

An examination of the stomachs of 16 black-billed cuckoos, taken during the summer months, showed the remains of 328 caterpillars, 11 beetles, 15 grasshoppers, 63 sawflies, 3 stink bugs, and 4 spiders. In all probability more individuals than these were represented, but their remains were too badly broken for recognition. Most of the caterpillars were hairy, and many of them belonged to a genus that lives in colonies and feeds on the leaves of trees, including the apple tree. One stomach was filled with larvæ of a caterpillar belonging to the same genus as the tent caterpillar, and possibly to that species. Other larvæ were those of large moths, for which the bird seems to have a special fondness. The beetles were for the most part click beetles and weevils, with a few May beetles and some others. The sawflies were all found in two stomachs, one of which contained no less than 60 in the larval stage.

Of the yellow-billed cuckoo, 21 stomachs (collected from May to October, inclusive) were examined. The contents consisted of 355 caterpillars, 18 beetles, 23 grasshoppers, 31 sawflies, 14 bugs, 6 flies, and 12 spiders.

As in the case of the black-billed cuckoo, most of the caterpillars belonged to hairy species and many of them were of large size. One stomach contained 12 American tent caterpillars; another 217 fall webworms. The beetles were distributed among several families, but all more or less harmful to agriculture. In the same stomach which contained the tent caterpillars were two Colorado potato beetles; in another were three goldsmith beetles and remains of several other large bettles. Besides ordinary grasshoppers were several katy-dids and tree crickets. The sawflies were in the larval stage, in which they resemble caterpillars so closely that they are commonly called false caterpillars by entomologists, and perhaps this likeness may be the reason the cuckoos eat them so freely. The bugs consisted of stink bugs and cicadas or dog-day harvest flies, with the exception of one wheel bug, which was the only useful insect eaten, unless the spiders be counted as such.

THE WOODPECKERS.

Five or six species of woodpeckers are familiarly known throughout the eastern United States, and in the west are replaced by others of similar habits. Several species remain in the northern States through the entire year, while others are more or less migratory.

Farmers are prone to look upon woodpeckers with suspicion. When the birds are seen scrambling over fruit trees and pecking at the bark, and fresh holes found in the tree, it is concluded that they are doing harm. Careful observers, however, have noticed that, excepting a single species, these birds rarely leave any important mark on a healthy tree, but that when a tree is affected by wood-boring larvæ the insects are accurately located, dislodged and devoured. In case the holes from which the borers are taken are afterwards occupied and enlarged by colonies of ants, these ants in turn are drawn out and eaten.

Two of the best known woodpeckers, the hairy woodpecker (*Dryobates villosus*) and the downy woodpecker (*D. pubescens*), including their races, range over the greater part of the United States, and for the most part remain throughout the year in their usual haunts. They differ chiefly in size, for their colors are practically the same, and the males, like other woodpeckers, are distinguished by a scarlet patch on the head.

An examination of many stomachs of these two birds shows that from two-thirds to three-fourths of the food consists of insects, chiefly noxious. Wood-boring beetles, both adults and larvæ, are conspicuous, and with them are associated many caterpillars, mostly species that burrow into trees. Next in importance are the ants that live in decaying wood, all of which are sought by woodpeckers and eaten in great quantities. Many ants are particularly harmful to timber, for if they find a small spot of decay in the vacant burrow of some wood-borer, they enlarge the hole, and as their colony is always on the increase, continue to eat away the wood until the whole trunk is honeycombed. Moreover, these insects are not accessible to other birds, and could pursue their career of destruction unmolested were it not that the woodpeckers, with beaks and tongues especially fitted for such work, dig out and devour them. It is thus evident that woodpeckers are great conservators of forests. To them, more than to any other agency, we owe the preservation of timber from hordes of destructive insects.

One of the larger woodpeckers familiar to everyone is the flicker, or golden-winged woodpecker (*Colaptes auratus*), which is generally distributed throughout the United States from the Atlantic Coast to the Rocky Mountains. It is there replaced by the red-shafted flicker (*C. cafer*), which extends westward to the Pacifi

The two species are as nearly identical in food habits as their environment will allow. The flickers, while genuine woodpeckers, differ somewhat in habits from the rest of the family, and are frequently seen upon the ground searching for food. Like the downy and hairy woodpeckers, they eat wood-boring grubs and ants, but the number of ants eaten is much greater. Two of the flickers' stomachs examined were completely filled with ants, each stomach containing more than 3,000 individuals. These ants belonged to species which live in the ground, and it is these insects for which the flicker is searching when running about in the grass, although some grasshoppers are also taken.

The red-headed woodpecker (*Melanerpes erythrocephalus*) is well known east of the Rocky Mountains, but is rather rare in New England. Unlike some of the other species, it prefers fence posts and telegraph poles to trees as a foraging ground. Its food therefore naturally differs from that of the preceding species, and consists largely of adult beetles and wasps, which it frequently captures on the wing, after the fashion of flycatchers. Grasshoppers also form an important part of the food. The redhead has a peculiar habit of selecting very large beetles, as shown by the presence of fragments of several of the largest species in the stomachs. Among the beetles were quite a number of predaceous ground beetles, and unfortunately some tiger beetles, which are useful insects. The redhead has been accused of robbing the nests of other birds; also of attacking young birds and poultry and pecking out their brains, but as the stomachs showed little evidence to substantiate this charge it is probable that the habit is rather exceptional.

It has been customary to speak of the smaller woodpeckers as "sapsuckers," under the belief that they drill holes in the bark of trees for the purpose of drinking the sap and eating the inner bark. Close observation, however, has fixed this habit upon only one species, the yellow-bellied woodpecker, or sapsucker (*Sphyrapicus varius.*) This bird has been shown to be guilty of pecking holes in the bark of various forest trees, and sometimes in that of apple trees, from which it drinks the sap when the pits become filled. It has been proved, however, that besides taking the sap the bird captures large numbers of insects which are attracted by the sweet fluid, and that these form a very considerable portion of its diet. In some cases the trees are injured by being thus punctured, and die in a year or two, but since comparatively few are touched the damage is not great. It is equally probable, moreover, that the bird fully compensates for this injury by the insects it consumes.

The vegetable food of woodpeckers is varied, but consists largely of small fruits and berries. The downy and hairy woodpeckers eat such fruits as dogwood, Virginia creeper, and others, with the seeds of poison ivy, sumac, and a few other shrubs. The flicker also eats a great many small fruits and the seeds of a considerable number of shrubs and weeds. None of the three species is much given to eating cultivated fruits or crops.

The redhead has been accused of eating the larger kinds of fruit, such as apples, and also of taking considerable corn. The stomach examinations show that to some extent these charges are substantiated, but that the habit is not prevalent enough to cause much damage. It is quite fond of mast, especially beechnuts, and when these nuts are plentiful the birds remain north all winter, instead of migrating as is their usual custom.

Half the food of the sapsucker, aside from sap, consists of vegetable matter, largely berries of the kinds already mentioned; and also a quantity of the inner bark of trees, more of which is eaten by this species than by any other.

Many other woodpeckers are found in America, but their food habits agree in the main with those just described. These birds are certainly the only agents which can successfully cope with certain insect enemies of the forests, and, to some extent, of fruit trees also. For this reason, if for no other, they should be protected in every possible way.

THE KINGBIRD.

(*Tyrannus tyrannus.*)

The kingbird is essentially a lover of the orchard, and wherever the native groves have been replaced by fruit trees this pugnacious bird takes up its abode. It breeds in all of the States east of the Rocky Mountains, and less commonly in the Great Basin and on the Pacific Coast. It migrates south early in the fall, and generally leaves the United States to spend the winter in more southern latitudes.

The kingbird manifests its presence in many ways. It is somewhat boisterous and obtrusive, and its antipathy for hawks and crows is well known. It never hesitates to give battle to any of these marauders, no matter how superior in size, and for this reason a family of kingbirds is a desirable adjunct to a poultry yard. On one occasion in the knowledge of the writer a hawk which attacked a brood of young turkeys was pounced upon and so severely buffeted by a pair of kingbirds, whose nest was near by, that the would-be robber was glad to escape without his prey. Song birds that nest near the kingbird are similarly protected.

In its food habits this species is largely insectivorous. It is a true flycatcher by nature, and takes a large part of its food on the wing. It does not, however, confine itself to this method of hunting, but picks up some insects from trees and weeds, and even descends to the ground in search of myriapods or thousand legs. The chief complaint against the kingbird is that it preys largely upon honeybees; and this charge has been made both by professional bee keepers and others. Many observers have seen the bird at work near hives, and there is no reason to doubt the honesty of their testimony. One bee raiser in Iowa, suspecting the kingbirds of feeding upon his bees, shot a number near his hives, but when the birds' stomachs were examined by an expert entomologist not a trace of honeybees could be found.

The Biological Survey has made an examination of 281 stomachs collected in various parts of the country, but found only 14 containing remains of honeybees. In these 14 stomachs there were in all 50 honeybees, of which 40 were drones, 4 were certainly workers, and the remaining 6 were too badly broken to be identified as to sex.

The insects that constitute the great bulk of the food of this bird are noxious species, largely beetles—May beetles, click beetles (the larvæ of which are known as wire worms), weevils, which prey upon fruit and grain, and a host of others. Wasps, wild bees, and ants are conspicuous elements of the food, far outnumbering the hive bees. During summer many grasshoppers and crickets, as well as leaf hoppers and other bugs, are also eaten. Among the flies were a number of robber flies—insects which prey largely upon other insects, especially honeybees, and which have been known to commit in this way extensive depredations. It is thus evident that the kingbird by destroying these flies actually does good work for the apiarist. Nineteen robber flies were found in the stomachs examined; these may be considered more than an equivalent for the four worker honeybees already mentioned. A few caterpillars are eaten, mostly belonging to the group commonly known as cutworms, all the species of which are harmful. About 10 per cent. of the food consists of small native fruits, comprising some twenty common species of the roadsides and thickets, such as dogwood berries, elder berries, and wild grapes. The bird has not been reported as eating cultivated fruit to an injurious extent, and it is very doubtful if this is ever the case, for cherries and blackberries are the only ones that might have come from cultivated places, and they were found in but few stomachs.

Three points seem to be clearly established in regard to the food of the kingbird—(1) that about 90 per cent. consists of insects, mostly injurious species; (2) that the alleged habit of preying upon honeybees is much less prevalent than has been supposed, and probably does not result in any great damage; and (3) that the vegetable food consists almost entirely of wild fruits which have no economic value. These facts, taken in connection with its well-known enmity for hawks and crows, entitle the kingbird to a place among the most desirable birds of the orchard or garden.

THE PHŒBE.

(*Sayornis phœbe.*)

Among the early spring arrivals at the North, none are more welcome than the phœbe. Though naturally building its nest under an overhanging cliff of rock or earth, or in the mouth of a cave, its preference for the vicinity of farm buildings is so marked that in the more thickly settled parts of the country the bird is seldom seen at any great distance from a farmhouse except where a bridge spans some stream, affording a secure spot for a nest. Its confiding disposition has rendered it a great favorite, and consequently it is seldom disturbed. It breeds throughout the United States east of the Great Plains, and winters from the South Atlantic and Gulf States southward.

The phœbe subsists almost exclusively upon insects, most of which are caught upon the wing. An examination of 80 stomachs showed that over 93 per cent. of the year's food consists of insects and spiders, while wild fruit constitutes the remainder. The insects belong chiefly to noxious species, and include many click beetles, May beetles, and weevils. Grasshoppers in their season are eaten to a considerable extent, while wasps of various species, many flies of species that annoy cattle, and a few bugs and spiders are also eaten regularly. It is evident that a pair of phœbes must materially reduce the number of insects near a garden or field, as the birds often, if not always, raise two broods a year, and each brood numbers from four to six young.

The vegetable portion of the food is unimportant, and consists mainly of a few seeds, with small fruits, such as wild cherries, elder berries, and juniper berries. The raspberries and blackberries found in the stomachs were the only fruits that might have belonged to cultivated varieties, and the quantity was trifling.

There is hardly a more useful species than the phœbe about the farm, and it should receive every encouragement. To furnish nesting boxes is unnecessary, as it usually prefers a more open situation, like a shed, or a nook under the eaves, but it should be protected from cats and other marauders.

THE BLUE JAY.

(*Cyanocitta cristata.*)

The blue jay is a common bird of the United States east of the Great Plains, and remains throughout the year in most of its range, although its numbers are somewhat reduced in winter in the Northern States. During spring and summer the jay is forced to become an industrious hunter for insects, and is not so conspicuous a feature of the landscape as when it roams the country at will after the cares of the nesting season are over.

Ornithologists and field observers in general declare that a considerable portion of its food in spring and early summer consists of the eggs and young of small birds, and some farmers accuse it of stealing corn to an injurious extent in the fall. While there may be some truth in these accusations, they have almost certainly been exaggerated. No doubt many jays have been observed robbing nests of other birds, but thousands have been seen that were not so engaged.

In an investigation of the food of the blue jay 292 stomachs were examined, which showed that animal matter comprised 24 per cent. and vegetable matter 76 per cent. of the bird's diet. So much has been said about the nest-robbing habits of the jay that special search was made for traces of birds or birds' eggs in the stomachs, with the result that shells of small birds' eggs were found in three and the remains of young birds in only two stomachs. Such negative evidence is not sufficient to controvert the great mass of testimony upon this point, but it shows that the habit is not so prevalent as has been believed. Besides birds and their eggs, the jay eats mice, fish, salamanders, snails and crustaceans, which altogether constitute but little more than 1 per cent. of its diet. The insect food is made up of beetles, grasshoppers, caterpillars, and a few species of other orders, all noxious, except some 3½ per cent. of predaceous beetles. Thus something more than 19 per cent. of the whole food consists of harmful insects. In August the jay, like many other birds, turns its attention to grasshoppers, which constitute nearly one-fifth of its food during that month. At this time, also, most of the other noxious insects, including caterpillars, are consumed, though beetles are eaten chiefly in spring.

The vegetable food is quite varied, but the item of most interest is grain. Corn was found in 70 stomachs, wheat in 8, and oats in 2—all constituting 19 per cent. of the total food. Corn is evidently the favorite grain, but a closer inspection of the record shows that the greater part was eaten during the first five months of the year, and that very little was taken after May, even in harvest time, when it is abundant. This indicates that most of the corn is gleaned from the fields after harvest, except what is stolen from cribs or gathered in May at planting time.

The jay's favorite food is mast (*i.e.*, acorns, chestnuts, chinquapins, etc.), which was found in 158 of the 292 stomachs and amounted to more than 42 per cent. of the whole food. In September corn formed 15 and mast 35 per cent., while in October, November and December corn dropped to an almost inappreciable quantity and mast amounted to 64, 82 and 83 per cent., respectively. And yet in these months corn is abundant and everywhere easily accessible. The other elements of food consist of a few seeds and wild fruits, among which grapes and blackberries predominate.

The results of the stomach examination show (1) that the jay eats many noxious insects; (2) that its habit of robbing the nests of other birds is much less common than has been asserted; and (3) that it does little harm to agriculture, since all but a small amount of the corn eaten is waste grain.

THE CROW.

(*Corvus americanus.*)

There are few birds so well known as the common crow, and unlike most other species he does not seem to decrease in numbers as the country becomes more densely populated. The crow is commonly regarded as a blackleg and a thief. Without the dash and brilliancy of the jay, or the bold savagery of the hawk, he is accused of doing more mischief than either. That he does pull up sprouting corn, destroy chickens, and rob the nests of small birds has been repeatedly proved. Nor are these all of his sins. He is known to eat frogs, toads, salamanders, and some small snakes, all harmless creatures that do some good by eating insects. With so many charges against him, it may be well to show why he should not be utterly condemned.

The examination of a large number of stomachs, while confirming all the foregoing accusations, has thrown upon the subject a light somewhat different from that derived solely from field observation. It shows that the bird's-nesting habit, as in the case of the jay, is not so universal as has been supposed; and that, so far from being a habitual nest robber, the crow only occasionally indulges in that reprehensible practice. The same is true in regard to destroying chickens, for he is able to carry off none but very young ones, and his opportunities for capturing them are somewhat limited. Neither are many toads and frogs eaten, and as frogs are of no great practical value, their destruction is not a serious matter; but toads are very useful, and their consumption, so far as it goes, must be counted against the crow. Turtles, crayfishes, and snails, of which he eats quite a large number, may be considered neutral, while mice may be counted to his credit.

In his insect food, however, the crow makes amends for sins in the rest of his dietary, although even here the first item is against him. Predaceous beetles are eaten in some numbers throughout the season, but the number is not great. May beetles, "dor-bugs," or June bugs, and others of the same family, constitute the principal food during spring and early summer, and are fed to the young in immense quantities. Other beetles, nearly all of a noxious character, are eaten to a considerable extent. Grasshoppers are first taken in May, but not in large numbers until August when, as might be expected, they form the leading article of diet; showing that the crow is no exception to the general rule that most birds subsist, to a large extent, upon grasshoppers in the month of August. Many bugs, some caterpillars, mostly cutworms, and some spiders are also eaten—all of them either harmful or neutral in their economic relations. Of the insect diet Mr. E. A. Schwarz says: "The facts, on the whole, speak overwhelmingly in favor of the crow."

Probably the most important item in the vegetable food is corn, and by pulling up the newly sprouted seeds the bird renders himself extremely obnoxious. Observation and experiments with tame crows show that hard, dry corn is never eaten if anything else is to be had, and if fed to nestlings it is soon disgorged. The reason crows resort to newly planted fields is that the kernels of corn are softened by the moisture of the earth, and probably become more palatable in the process of germination, which changes the starch of the grain to sugar. The fact, however, remains that crows eat corn extensively only when it has been softened by germination or partial decay, or before it is ripe and still "in the milk." Experience has shown that they may be prevented from pulling up young corn by tarring the seed, which not only saves the corn but forces them to turn their attention to insects. If they persist in eating green corn it is not so easy to prevent the damage; but no details of extensive injury in this way have yet been presented, and it is probable that no great harm has been done.

Crows eat fruit to some extent, but confine themselves for the most part to wild species, such as dogwood, sour gum, and seeds of the different kinds of sumac. They have also a habit of sampling almost everything which appears eatable, especially when food is scarce. For example, they eat frozen apples found on the trees in winter, or pumpkins, turnips, and potatoes which have been overlooked or neglected; even mushrooms are sometimes taken, probably in default of something better.

In estimating the economic status of the crow, it must be acknowledged that he does some damage, but, on the other hand, he should receive much credit for the insects which he destroys. In the more thickly settled parts of the country the crow probably does more good than harm, at least when ordinary precautions are taken to protect young poultry and newly-planted corn against his depredations. If, however, corn is planted with no provision against possible marauders, if hens and turkeys are allowed to nest and to roam with their broods at a distance from farm buildings, losses must be expected.

THE BOBOLINK, OR RICEBIRD.

(Dolichonyx oryzivorus.)

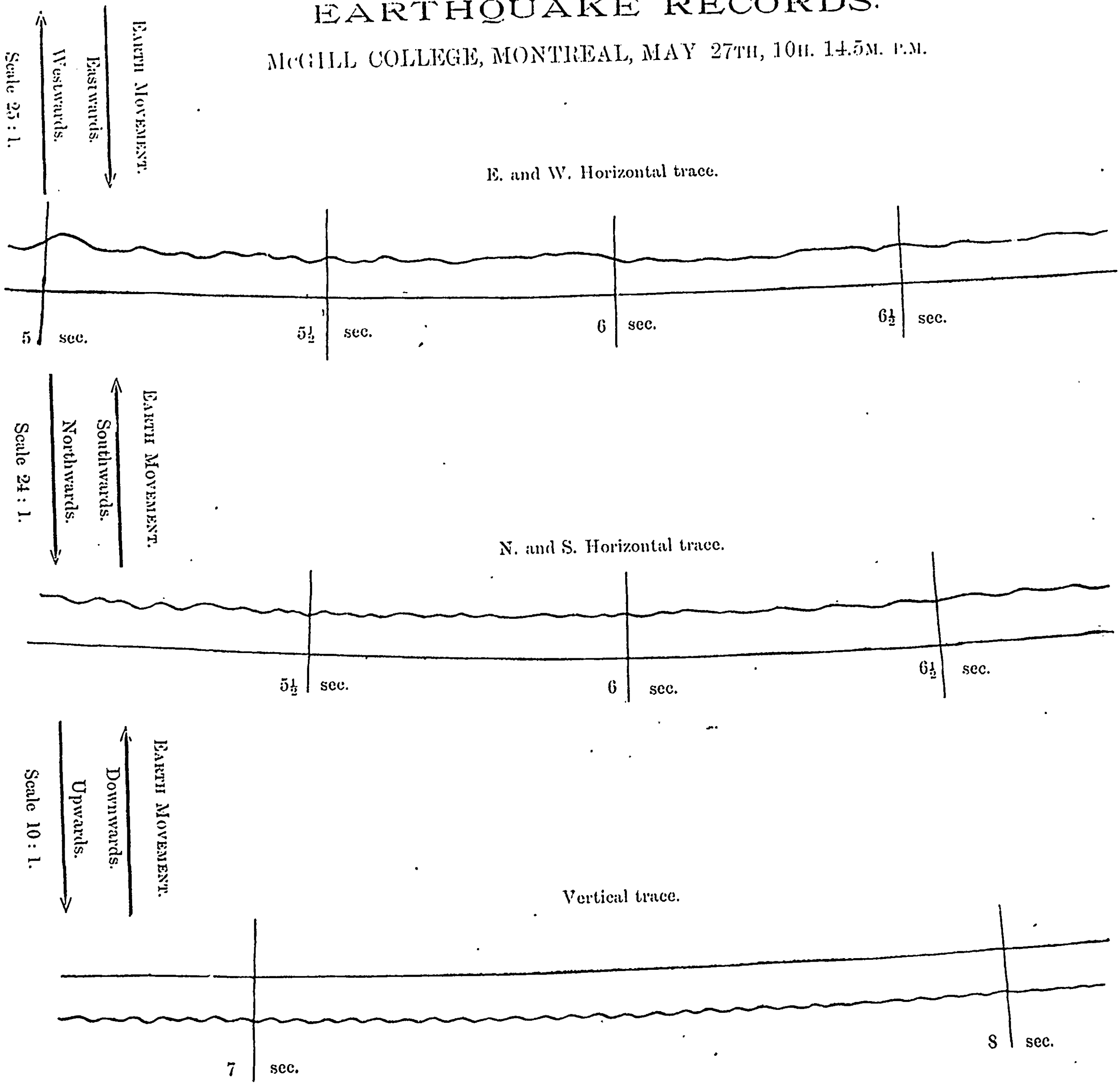
The bobolink is a common summer resident of the United States, north of about latitude 40°, and from New England westward to the Great Plains, wintering beyond our southern border. In New England there are few birds, if any, around which so much romance has clustered; in the South none on whose head so many maledictions have been heaped. The bobolink, entering the United States from the South at a time when the rice fields are freshly sown, pulls up the young plants and feeds upon the seed. Its stay, however, is not long, and it soon hastens northward, where it is welcomed as a herald of summer. During its sojourn in the Northern States it feeds mainly upon insects and small seeds of useless plants; but while rearing its young, insects constitute its chief food, and almost the exclusive diet of its brood. After the young are able to fly, the whole family gathers into a small flock and begins to live almost entirely upon vegetable food. This consists for the most part of weed seeds, since in the North these birds do not appear to molest grain to any great extent. They eat a few oats, but their stomachs do not reveal a great quantity of this or any other grain. As the season advances they gather into larger flocks and move southward, until by the end of August nearly all have left their breeding grounds. On their way they frequent the reedy marshes about the mouths of rivers and on the inland waters of the coast region, subsisting largely upon wild rice. After leaving the Northern States they are commonly known as reed birds, and having become very fat are treated as game.

They begin to arrive on the rice fields in the latter part of August, and during the next month make havoc in the ripening crop. It is unfortunate that the rice districts lie exactly in the track of their fall migration, since the abundant supply of food thus offered has undoubtedly served to attract them more and more, until most of the bobolinks bred in the North are concentrated with disastrous effect on the South-east coast when the rice ripens in the fall. There was evidently a time when no such supply of food awaited the birds on their journey southward, and it seems probable that the introduction of rice culture in the South, combined with the clearing of the forests in the North, thus affording a larger available breeding area, has favored an increase in the numbers of this species. The food habits of the bobolink are not necessarily inimical to the interests of agriculture. It simply happens that the rice affords a supply of food more easily obtainable than did the wild plants which formerly occupied the same region. Were the rice fields at a distance from the line of migration, or north of the bobolinks' breeding ground, they would probably never be molested; but lying, as they do, directly in the path of migration, they form a recruiting ground, where the birds can rest and accumulate flesh and strength for the long sea flight which awaits them in their course to South America.

The annual loss to rice growers on account of bobolinks has been estimated at $2,000,000. In the face of such losses it is evident that no mere poetical sentiment should stand in the way of applying any remedy which can be devised. It would be unsafe to assume that the insects which the birds consume during their residence in the

EARTHQUAKE RECORDS.

McGILL COLLEGE, MONTREAL, MAY 27TH, 10H. 14.5M. P.M.



North can compensate for such destruction. If these figures are any approximation to the truth, the ordinary farmer will not believe that the bobolink benefits the Northern half of the country nearly as much as it damages the Southern half, and the thoughtful ornithologist will be inclined to agree with him. But even if the bird really does more harm than good, what is the remedy? For years the rice planters have been employing men and boys to shoot the birds and drive them away from the fields, but in spite of the millions slain every year their numbers do not decrease. In fact, a large part of the loss sustained is not in the grain which the birds actually eat, but in the outlay necessary to prevent them from taking it all. At present there seems to be no effective remedy short of complete extermination of the species, and this is evidently impracticable even were it desirable.

Note on the Earthquake of May 27th, 1897.

The earthquake shock of May 27th, although not as severe as that of March 23rd, extended over a somewhat larger area. The district principally affected was, however, the same as on March 23rd and 26th, the centre of the disturbance being in each case the Island of Montreal. Reports of this shock were received from places covering a distance of approximately 350 miles along the St. Lawrence by a width of 250 miles.

The first rumbling was observed at 10h. 14m. 20s. p.m. (Eastern standard time), the main shock occurred at 10h. 14m. 30s., and the vibrations were appreciable to the senses until 10h. 15m. 25s. A subsequent earth tremor without distinct shock was also observed in Montreal, commencing at 10h. 45m. 20s. and continuing for 40 seconds.

The accompanying plates are greatly enlarged copies of portions of the traces obtained on the Seismograph at the

McDonald Physics Building. The greatest vertical movement there recorded amounted to $\frac{1}{100}$th of an inch, the greatest movement in a north and south direction was $\frac{1}{500}$th of an inch, and the greatest in the east and west direction $\frac{1}{280}$th of an inch.

The seconds marked on the traces indicate the time elapsed from the instant of starting the Seismograph. A certain amount of vibration is, of course, required to make the electrical contact which sets the machinery in motion.

C. M. and H. C.

Outline of the President's Retiring Address.

After thanking the members of the Society for the honour they had done him in electing him twice in succession to the highest office in their gift, and for the loyal support they had given him in the performance of his duties as President, he proceeded to review the work of the Society for the past two years.

1. He had to congratulate the Society upon the number of valuable papers which had been laid before it at the monthly meetings during the past two sessions. One of the special duties devolved upon the President was to secure original contributions on Natural History for those meetings. His endeavour had been to have all departments of Natural History represented in the communications made to the Society; and at least a measure of success in this aim had been secured. Important additions had been made to the volume of Canadian science by our members in the papers they submitted. But more might have been accomplished in this direction if all the members had charged themselves with co-operating according to their tastes, knowledge and opportunities. It ought not to be forgotten that the main object for which the Society exists was to foster a taste

for original research. It was a rallying centre for all persons in the community that were students of nature, and if members would lay themselves out to put the Society in possession, by written communications, of such observations as they had made on the departments of Natural History in which they were severally interested, it would at once be a stimulus to themselves to prosecute more eagerly their special line of study, and a great help to make the ordinary meetings of the Society attractive and useful. He could himself testify how the obligations under which he had lain to the Society had engaged him to lose no opportunity of providing matter in the department in which he worked as an amateur which might be serviceable to the Society. He knew that many more of the members who, like himself, were amateurs, and made the prosecution of some branch of science a holiday pastime, could produce papers that would be of value in widening the knowledge of science among the citizens; and he felt that the Natural History Society would not only strengthen itself, but would help to embellish the lives and adorn the homes of the mercantile and professional classes of Montreal, if it became the means of inducing many more of them to take up the study of some branch of Natural History.

2. Great improvements had been made in the Society's Museum. It was through the agency of the Museum—by the training which it gave, familiarizing those who frequented it with the acquisitions of Natural Science—that they expected to accomplish much of their work as a society, which aimed at encouraging the study of nature. They had been receiving from time to time additions to it in the way of donations from friends, and occasionally by exchanges, but in some departments it was far from being as complete as they could desire, if it was to exercise the educational influence they wished. It was, therefore, desirable that there should be a fund available

for the purchase of specimens. And, then, some expenditure was necessary towards cleaning and re-arranging the specimens they had. Much had been done with small means already in this direction by our zealous Honorary Curator, Mr. J. B. Williams, but much remained to be done, and in view of the prospective visit of so many distinguished men of science to Canada during the present summer, it would be well if a liberal grant could be at once made for this purpose. As to the Botanical specimens which he had himself collected for the Museum, and for which, through the kindness of the First Vice-President, Mr. J. S. Shearer, a cabinet had been provided, he hoped to have time this summer to have them duly arranged and deposited in the cabinet.

3. The Somerville Courses of Lectures of the two last seasons had been exceptionally able, popular and useful. The Course of 1896 had dealt with the natural products of the fields and forests of the Dominion, which are of economic value, and it was made specially interesting and valuable by being contributed to by the staff of the Government Experimental Farms. The lectures of the present year covered the field of human physiology, and they were most instructive and highly appreciated by the public, the attendance at them being unprecedentedly large. The Society was greatly indebted to the physicians of the city, who had so kindly placed their special scientific attainments at its disposal, for the enlightenment of the people, on the department of Natural Science which was of the greatest practical utility, and most nearly concerned the welfare of the race—the laws of human life. The last two Somerville Courses had done not a little to popularize science, and had thus promoted the aim of the founder.

4. The Record of Science still maintained its high character, and reflected the greatest credit on the Society. The issuing of this important publication, if nothing more

were accomplished, would justify the existence of the Natural History Society. To place within reach of the workers in Natural History a vehicle for communicating to the world the results reached was a very great service rendered to science. Such service the journal of this Society had long rendered, and no sacrifice the Society could make would be too great in continuing the publication, by which it extended its influence even far beyond the confines of the Dominion.

5. During the past two seasons the Society made a new departure which gives promise of the best results in instituting half hour Saturday afternoon lectures on Natural History, specially for the instruction of children. In this way good seed had been sown, and it was not too much to expect that the Society would in due time reap an abundant harvest from it, in finding added to its active membership not a few of those in whom a taste for the study of nature was first awakened at these Saturday lecturettes. For the initiation of this popular movement the credit was largely due to the Museum Committee, with the Honorary Curator at its head.

In leaving the chair, the President regretted one thing —that he had not been able, during his term of office, to endeavour raising a fund for enabling the Somerville foundation to pay the lecturers who honoured the Society by appearing on its platform. Many years ago he had been named convener of a committee having this aim in view. The subject had been talked of during the past year, but in view of the depressed financial situation it was deemed best not to make the attempt. It would be a great advantage to the Society to have a fund by which the services of distinguished lecturers could be secured. As Mr. Somerville's ecclesiastical successor, he naturally wished to see this important result reached; and if at any future time an effort in that direction were made, the Society might command any assistance he could render.

Field Day to Riviere Rouge.

Notwithstanding the fact that the official weather prophets had predicted that Saturday would be somewhat cold, with local showers, which is their modest way of describing a rainy, cheerless day, about a hundred and seventy-five persons boarded the special train at Windsor street station that had been engaged to convey the members of the Natural History Society to River Rouge for their annual field day. The number would have undoubtedly been greater had not the general opinion been that the weather would prove unfavorable for the occasion, but for those who participated in the excursion the decreased number was rather a benefit than otherwise. as there was no crowding on the cars, which rendered the run out and back all the more enjoyable.

The special train left the city about nine o'clock, and although the sky was at that time clouded over, Montreal island had scarcely been left behind before the clouds had all broken up and there appeared every prospect of a fine day. The run of sixty-two miles was made in two hours and a half, the comparatively long time being easily explained by the fact that it was a single-track road, which was pretty busy all day ; consequently rather long waits had to be made at some of the stations, although good time was made when actually running.

Prof. Frank D. Adams, the President of the Society, was unavoidably absent, so the party was, while on the train, in charge of Mr. John S. Shearer, the First Vice-President, the Secretary of the Excursion Committee, Mr. J. Stevenson Brown, assuming direction on arrival at River Rouge. River Rouge is a lumbering settlement belonging to the Hon. J. K. Ward, at the mouth of the river of that name, where it enters the Ottawa, just a couple of miles north-west of Calumet station. From the railway to the Ottawa river, about a quarter of a mile to one's left when going west, the ground is clear, and on it is built the lumbermen's shanties. On the right are hills that are thickly covered with forest of a virgin growth, having evidently been denuded of their timber in years gone past. The lumber is at the present time obtained some distance further up the River Rouge. Having arrived opposite the settlement, the party quickly disembarked, the cars returning to Calumet station, there to be side-tracked till the return.

At this point Mr. J. Stevenson Brown detailed to the party the programme arranged for the day; three parties would be formed of those willing to join for the purpose of hunting for geological, botanical and entomological specimens respectively. On behalf of the Hon. J. K. Ward, he also invited the party to a lunch of lumbermen's fare at the shanty, which was then ready. Acting upon the latter suggestion, most of the party adjourned to the shanty to partake of cold boiled pork, pea soup, boiled beans, bread and butter, all served up in lumbermen's ware, and green tea without milk or sugar, which was drunk out of tin pannikins. If the fare was plainer than that to which some of the guests were used, it was good and wholesome, and great inroads were made upon it by those whose appetites were sharp set. After lunch the exploring parties assembled and went off on their respective quests, the remainder of the guests taking walks through the woods or by the river side to watch the progress of the large logs that are brought down by the swift river current from above. The sun was found to be quite hot, hotter by far than on any previous day of this year, and the shade of the trees was much appreciated. The insects of the species that regarded the visitors in the light of so many edibles held a picnic on their own account, as the faces and hands of many of the guests soon bore witness. The mosquitoes especially must have enjoyed a course of city people after the hardskinned lumbermen that they have, as a rule, to put up with. But neither heat nor yet mosquitoes affected the ardor of the explorers. In and around the woods they went, keen on specimens, and were able to record good "bags" by the time their hunting was over. Some members of the party engaged in fishing, but whether the water at this point is too much disturbed by the floating logs or whether the fish were nervous, or what, the latter proved shy and refused to bite, leaving that work to the mosquitoes. Some of the more adventurous, especially the boys, clambered over the piles of logs that were collected at corners on the banks till they reached the outermost edge, to sit there within a foot or so of the swirling current that tossed the logs about on its seething surface as if they were so many splinters. Those who desired still more exercise scaled the rocky heights which fenced in the river till they reached a chute of noble appearance some three-quarters of a mile from the river mouth.

Everything, however, must come to an end, and from about four o'clock, in twos and threes, the members of the party commenced to assemble at the rendezvous agreed upon close by the railway track. The exploring parties were in the midst of comparing notes when, punctually to the minute, the special train again made its appearance and was at once boarded. After a few minutes' waiting and whistling for stragglers, the start was made for home. The halts made at the stations were longer than during the run out, trains coming in the opposite direction having to be waited for, but as the speed when running was about forty-five miles an hour and the cars cool and comfortable, the time passed quickly enough. Through the kindness of Sir William Van Horne, refreshments were served to the party on the train, and were much appreciated after the ramble through the woods. While *en route* for the city the names of the prize winners of the day in the various sections were announced.

In the geological section, under the leadership of Mr. Nevil N. Evans, no report was made. In the botanical party, which had been under the leadership of the Rev. G. Colborne Heine, Miss F. E. Currie, of 43 Lorne avenue, won the prize for the largest of named specimens, having twenty-three, Miss Urquhart, of 12 St. Famille street, winning that for unamed, having thirty-three specimens. In the entomological section, which was led by Mr. J. B. Williams, Mr. H. T. Pye, of 141 Stanley street, tied with Mr. G. A. Moore, of 24 Lorne avenue, each having caught nineteen different kinds of insects.

The party included, among others, Mr. and Mrs. John S. Shearer, Miss Shearer, the Hon. J. K. Ward, Mr. Albert Holden, Mr. F. W. Richards, Mr. N. N. Evans, the Rev. G. Colborne Heine, Mr. James Slessor, Mr. Stewart Munn and Miss Munn, the Misses Van Horne, Miss F. Campbell, Mr. James Baylis and Miss Baylis, Mr. and Mrs. A. R. Grafton, Mr. A. S. Ewing and Miss Ewing, Dr. Welsey Mills, Mr. J. B. Williams, Miss F. E. Currie, Miss Urquhart, Mr. H. T. Pye, Mr. G. A. Moore, Mr. and Mrs. T. H. Cripps and Miss Cripps, Mr. and Mrs. Robert Law, Mr. C. T. Williams and Miss Williams, Mr. Andrew Baile, Mr. H. McLaren, Mr. William Agnew, Mr. and Mrs. Charles Garth, Mrs. E. Bulmer (Detroit), Dr. and Mrs. Lovejoy, Mr., Mrs. and the Misses H. Cameron, Miss Paterson (Boston), Mrs, S. Patterson, (Port Hope), Mr. J. Stevenson Brown, Mr. C. S. J., Master and Miss Philips, Mr. and Miss Cayford, Mr. and Mrs. John Fair, Mrs. Kerr, Mr., Mrs. and Miss McCombe.

Montreal was reached at about half-past seven, after what every one admitted to have been a most successful day.

A hearty vote of thanks was accorded by the party to the Hon. J. K. Ward for his kindness in arranging for the guests at River Rouge, and three cheers were given for the C. P. R., who had so ably arranged for their comfort on the way out and home.

Report of Chairman of Council of the Natural History Society of Montreal, for the Year ending 27th May, 1896.

The Chairman of Council begs to report that the work of the Council has been regularly carried on during the past year. Nine meetings of Council have been held and eight meetings of the Society, all of which have been well attended, and showing increased interest in the work of the Society.

The Annual Field Day Excursion took place on the first Saturday in June of 1896, going to Ste. Jovite and proving a very attractive outing.

THE CANADIAN RECORD OF SCIENCE continues to be issued, due to the liberality of some of our members, as we are still without the Government grant for this purpose.

The Somerville Course of Lectures for the session 1897 proved a very enjoyable one, and was largely attended. The eight lectures were as follows, an extra being given by Dr. H. M. Ami on "Extinct Monsters" after the close of the regular Course:—

Thursday, Jan. 14th.—"Food and Digestion: What we Eat and what Becomes of it," by W. S. Morrow, M.D.

Thursday, Jan. 21st.—"The Blood and its Circulation and Distribution in the Body," by John W. Scane, M.D.

Thursday, Jan. 28th.—"Respiration: What, Why and How we Breathe," by A. Bruere, M.D.

Thursday, Feb. 4th.—"Waste and Repair: The Body as a Factory," by G. Gordon Campbell, M.D.

Thursday, Feb. 11th.—"The Nervous System: The Mechanism that Governs the Body and how it does it," by Neil D. Gunn, M.D.

Thursday, Feb. 18th.—"The Senses: How and what we Learn of the World about us," by A. Proudfoot, M.D.

Thursday, Feb. 25th.—"Voice and Speech: How we Sing and Speak," by H. S. Birkett, M.D.

Thursday, March 4th.—" Age and Function : The Body and its Work at Different Periods of Life," by D. J. Evans, M.D.

The Saturday Half Hour Lectures to Young People proved very popular and attracted large numbers of the young folk. Unfortunately Mr. Kearley was too ill to give his paper.

The attendance at the Museum has been large, showing an increase over last year. On Saturdays, being a free day, we have sometimes had as many as one hundred visitors.

Many interesting additions have been made to the Museum during the past year.

It is very desirable that some of our wealthy citizens should do something in the way of an endowment fund towards helping on the good work of the Society.

Natural History classes are now being held at the Protestant schools, which is a step in the right direction.

We have to mourn the loss through death during our past year of the Rev. Dr. Smyth, Messrs. E. D. Lacey, John Kerry Geo. Kearley, Dr. Gentles and Mr. J. H. R. Molson, some of whom were very active members. We have added fifteen new names to our membership list.

The whole respectfully submitted.

GEO. SUMNER,
Chairman of Council.

MUSEUM REPORT FOR 1896–7.

The cleaning and re-arranging of the Foreign Birds has been completed this year, and, with the exception of the Humming Birds, they have all been named and labelled.

A large part of the "Ferrier" Collection of Egyptian Curiosities has also been cleaned, re-arranged and re-labelled.

A number of specimens were obtained by the Curator while in England last summer, in exchange for some of our duplicates, and at the same time an interesting series of British birds, nests and eggs were presented to the Museum by Mr. R. W. Chase, of Birmingham.

None of the live reptiles which were brought over by the Curator from the Zoological Gardens in London and from the Derby Museum, Liverpool, have survived the winter, *except three English frogs.*

The Crocodile and Puff Adder have, however, been mounted, and, in this form, will remain as permanent additions to the Museum.

Other additions might be made in exchange for some of our duplicates, as opportunities occur, and so gaps in our collections might be filled up.

Our Canadian series of Mustelidæ (the Weasel family) is complete, *with the exception* of the *Wolverene;* and our birds are, at present, without any specimen of the *Vulture* family.

Two cases of Canadian Beetles, which have been stored away for some years, have been cleaned, re-arranged and placed on exhibition near the Insect Cabinet, and though not a complete series, they give a good general idea of the principal families of Coleoptera that are found in this country.

The Entomological Society propose to make considerable additions this year to the insect department.

Mr. Dunlop has named and arranged a number of birds' eggs, and I have placed movable covers over the egg cases to prevent injury from too much light.

Complete lists of additions and donations have been given at our monthly meetings, and need not, therefore, be repeated here in detail.

The Museum Committee arranged for the series of Saturday afternoon lectures to young people during the months of February and March on different objects in the Museum, the attendance at which was very good. Last year the numbers rather fell away towards the close of the Course, but this year the largest attendances were at the two or three closing lectures.

The number of visitors to the Museum has been considerably larger than last year. On Saturday—the free day—it has varied from 10 or 12 to about 100. On the other days, when only members are free, the number of visitors has been about 350, so that, including also the evenings of the Somerville Lectures, about 2,000 visitors must have been to the Museum during the year.

There is still much work needed to put the whole Museum into a good state of order. The collection of Fishes, and also that of Minerals, requires cleaning, re-arranging and labelling, and there are many objects stored away in drawers and cupboards, which would form interesting and valuable additions to the Museum if they were put into a proper state for exhibition.

J. B. WILLIAMS,
Curator.

Montreal, June 3rd, 1897.

NATURAL HISTORY SOCIETY OF MONTREAL,

IN ACCOUNT WITH

F. W. RICHARDS, *Hon. Treas.*

FROM MAY 28TH, 1896, TO JUNE 3RD, 1897.

Dr.

To balance cash on hand	$232 50
" Rents	900 00
" Members' Subscriptions	587 00
" Donations	213 00
" Entrance Fees to Museum	21 50
" Rebate of tax *re* widening Palace Street	18 20
" RECORD OF SCIENCE	15 08
" Cash from sale of old benches	9 00
" Surplus from Field Day and Conversazione	3 61
" Interest as per bank book	1 64
	$2001 53

Cr.

By Superintendent's Salary (13 months), $494.00 ; Commission, $50.85	$544 85
" Record of Science	288 02
" Repairs and Renovations	211 31
" Museum	206 27
" Lighting	139 68
" Fuel	137 85
" Sundry Expenses	128 41
" Fire Insurance	127 50
" Printing	95 08
" Lecture	49 45
" City Water Tax	33 95
" Cash on hand	39 16
	$2001 53

Audited and found correct,

A. Holden,

Montreal, June 3rd, 1897.

The receipts ($1769.03) for the past year shew a falling off of nearly one hundred dollars, due to the failure of our usual surplus from the Field Day, which, combined with a margin, netted only $3.61, as compared with $83.18 of the previous year, together with $35 less revenue from rents from the building. In 1896 the revenue included the sum of $223.18, proceeds of the sale of the dividing wall with the premises next door. The total amount of the different items in which there is a decrease is $126.19, added to the proceeds of the dividing wall, shew a total of $349.35. As an offset to this heavy handicap, on the past year's finances I am very glad to announce that economical and prudent management has enabled us to close the year with no outstanding accounts, and with a small balance in hand. There is a liability, however, in connection with the Record of Science, but the printers have not yet rendered their account, and I am unable to say what the exact amount is (probably $150). I am also pleased to be able to say that the following items of our income shew an increase :—

Membership Subscriptions	$587.00	against	$562.00	Increase,	$ 25.00
Donations	213.00	"	25.00	"	188.00
RECORD OF SCIENCE	15.08	"	3.80	"	11.28
Entrance Fees to Museum	21.50	"	12.90	"	8.60
Rebate of Tax	....	"	....	"	18.20
					$251.08

In our expenditure the following items shew a decrease:

Light Account	$139.68	against	$207.40	Decrease,	$67.72
Library and Museum	206.27	"	285.67	"	79.40
Sundry Expense Account	128.41	"	163.10	"	34.79
RECORD OF SCIENCE	288.02	"	360.86	"	72.84
					$254.75

The building and contents are insured against fire to the amount of $21,000. The premiums were paid last June, $127.50 for three years, so that for the next two years this item will not have to be provided for.

In connection with the reseating of the Hall, it may be interesting to note that we have received from the sale of old benches (one only remaining on hand), $32.50; the Plymouth Brethren paid towards the new chairs, $50.00; value of bench on hand, $1.00; total, $83.50.

This amount deducted from the cost of the new chairs, $175.00, shews a net cost to the Society of $92.50 for this much-needed improved seating for the Hall.

In conclusion, I would beg to urge all present to assist in making our Annual Field Day on Saturday the success which from the Treasurer's point of view is only calculated upon the amount handed to him when the accounts are adjusted, which has ranged all the way from $35 to $83 during the past seven years, excepting last year, when coupled with the conversazione, we only realized $3.61. Not since 1889, when $8.72 was the surplus, has such a poor showing resulted, and I earnestly hope that Mr. Shearer will have the pleasure of handing me at least one hundred dollars in order to, in a small measure, make up for what we ought to have had last year.

Report of the Library Committee.

I have to acknowledge the very useful and intelligent help I have received from Mr. Griffin, the Superintendent, which is always so readily and cheerfully given, and without which the work done could not have been accomplished.

There is little to report concerning the Library, as the whole time the Librarian has had for the work has been spent in receiving and acknowledging the exchanges and in completing the arrangement of the books in the cases, and making a list of the books as they stand on the shelves. A copy of this list has been placed in each of the cases. When these are arranged alphabetically an important step will have been taken in the preparation of the general catalogue. A large number of volumes are ready for the binder, but as the glass cases are full and the closets under them filled with works in Russian, Spanish, Italian and Swedish languages, there will be no room for the accumulating volumes. It will, therefore, be the work of the Committee for the ensuing year to provide additional shelving.

It is encouraging to find that the library has been more frequented by members than formerly.

I have to acknowledge the donation of a copy of the Geological Atlas of the United States from the United States Geological Survey, also a copy of Wental's History of Birds of Montreal from Mr. Drysdale, the publisher.

Fears were entertained that the tariff proposed by Mr. Laurier's Government would interfere with the receiving of the exchanges from foreign countries. The Council of the Society, therefore, petitioned the Finance Minister on the subject, and it is hoped that the changes made in the tariff will allow these books to come to us free of duty.

Respectfully submitted.

E. T. Chambers,
Hon. Librarian.

REPORT OF THE EDITING AND EXCHANGE COMMITTEE.

GENTLEMEN,—During the past year the publication of the *Canadian Record of Science* has continued as usual. Three numbers have been issued already, and a fourth is now in press. It has, however, unfortunately, been found to be impossible to issue the several numbers on the dates when they were due, owing to the absence of the Editor from town during the summer months.

The rule of accepting only papers of merit and as far as possible only original papers for publication has been adhered to and a high standard has thus been maintained. One or two papers which appeared in German periodicals, and which were of especial importance to scientific workers in Canada, have also been translated and published.

As in past years, a large number of valuable exchanges have been received for the *Record* and placed in the library.

Respectfully submitted.

FRANK D. ADAMS,
Chairman.

BOOK NOTICE.

Lawrence M. Lambe, F.G.S., F.G.S.A., of the Canadian Geological Survey, has published in the Transactions of the Royal Society, in successive years ('92, '93, '94) three monographs on the sponges of the Western coast of Canada and Behring Sea, also in '96 a monograph on the Atlantic coast sponges.

He has described and catalogued 56 species from the West coast, most of which are new and belong chiefly to the Monaxonida.

Those from the East coast number 30 modern and one fossil, *Craniella Logani.*

It is interesting to note that seven species and most of the genera are common to both coasts. It is rather unfortunate that the last publication is in the octavo form, as it precludes binding them together.

These publications bring this somewhat neglected part of Canadian *Zoology well up to date, and forms a ready and valuable means* of determining the sponges which are so abundant on our coasts. The illustrations and descriptions are well executed and complete, which greatly facilitates their determination. The collection from the West coast were made by a large number of men, those from the East coast chiefly by Sir William Dawson and Mr. Whiteaves. The following are lists of species, catalogued and described by him from the respective coasts :—

SPONGES FROM THE PACIFIC COAST.

Monaxonida.

Axenella rugosa
Chondrocladia Alaskensis
Chondrocladia pulchra
Clathria levigata
Clathria Loveni
Desmacella pennata
Esperella adhaerens
Esperella helios
Esperella hispida
Esperella lingua
Esperella modesta
Esperella occidentalis
Esperella serratohamala
Esperiopsis laxa
Esperiopsis Quatsinoensis
Esperiopsis rigida
Esperiopsis Vancouverensis
Eumastia sitiens
Halichondria disparalis
Halichondria panicea
Iophon chelifer
Iotrochota magna
Myxilla Amakuakensis
Myxilla Barentsi
Myxilla Behringensis
Myxilla firma
Myxilla lacumsa
Myxilla parasitica
Myxilla rosacea
Petrosia hispida
Phakellia Dalli
Phakellia papyracea
Phakellia ventilabrum
Plocamia Manaarensis
Polymastia laganoides
Polymastia Pacifica
Reniera cinerea
Reniera mollis
Reniera rufescens
Suberites concinnus
Suberites latus
Suberites montalbidus
Suberites montiniger
Suberites simplex
Suberites subena
Tedania fragilis
Toxochalina borealis

Tetractinellidae.

Craniella spinosa
Craniella villosa
Cydonium Mülleri

Hexactinellidae.

Aphrocalliste Whiteavesianus
Bathydorus Dawsoni
Rhabdocalyptus Dowlingii

Calcarea.

Grantia Comoxensis
Lenconia pyriformis
Sycon compactum

SPONGES FROM THE ATLANTIC COAST.

Monaxonida.

Chalnia oculata
Cladorhiza abyssicola
Cladorhiza Nordenskiöldii
Clathria delicata
Cliona celata
Desmacidon (Homeodictya) palmata
Desmacella Peachiibar Groenlandica
Esperella lingua
Esperella modesta
Eumastia sitiens
Gellius arcoferus
Gellius flagellifer
Halichondria panicea
Iophon chelifer
Myxilla incrustans
Phakellia ventilabrum
Polymastia mammilaris
Polymastia robusta
Reniera mollis
Reniera rufescens
Stylocordyla borealis
Suberites ficus
Suberites hispidus
Tentorium semisuberites
Trichostemma hemisphaericum

Tetractenellida.

Tethea muricata
Craniella Logani (fossil)

Calcarea.

Grantia Canadensis
Leneosolenia cancellata
Sycon asperum
Sycon protectum

ABSTRACT FOR THE MONTH OF JUNE, 1897.

Meteorological Observations, McGill College Observatory, Montreal, Canada. Height above sea level, 187 feet, C. H. McLEOD, *Superintendent.*

DAY	Thermometer Mean.	Thermometer Max.	Thermometer Min.	Thermometer Range.	Barometer Mean.	Barometer Max.	Barometer Min.	Barometer Range.	†Mean pressure of vapor.	Mean relative humidity.	Dew Point.	Wind General direction.	Wind Mean velocity in miles per hour	Sky Clouded in Tenths Mean.	Sky Clouded in Tenths Max.	Sky Clouded in Tenths Min.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	51.45	60.1	46.0	14.1	29.8513	30.008	29.791	.217	.2393	61.8	39.0	N.W.	21.04	4.5	10	0	43	...	....	....	1
2	53.35	61.2	41.5	19.7	30.0728	30.131	30.029	.102	.2147	52 0	36 0	W.	16.71	4.7	10	0	70	....	....	....	2
3	50.77	52.7	49.8	2.9	29.8150	29.991	29.733	.258	.3358	90 7	48 0	N.E.	10.32	10.0	10	10	0	0.36	....	0.36	3
4	58.73	69.4	49.0	20.4	29.7848	29.824	29.763	.061	.3933	80.3	52.5	W.	16.46	6 8	10	0	41	0.01	......	0.01	4
5	60.43	68.7	53.0	15.7	29.8928	29.932	29.873	.059	.3728	71.8	51.0	S.W.	8.68	6.2	10	0	48	....	....	....	5
SUNDAY....... 6	.....	75.0	53.0	22.0	......	.....	....	.....	......	....	....	S.W.	7.12	....	..	..	91	....	....	....	6..........SUNDAY
7	61.95	70.6	52.8	17 8	30.1538	30.187	30.116	.071	.4013	73.3	53.0	S.E.	12.37	5.3	10	0	39	....	....	....	7
8	57.38	61.8	51.0	10.8	30.1968	30.215	30.184	.031	.3370	71.5	48.2	S.E.	14.12	8.8	10	5	12	0.00	....	0.00	8
9	54.77	57.4	52.8	4.6	30.1475	30.207	30.068	.139	.3920	90 8	52 3	S E.	7.20	10 0	10	10	0	0.35	....	0.35	9
10	57.45	66.4	52.0	14.4	30.0120	30.048	29.980	.068	.4212	89.5	54.2	N E.	10.62	8 2	10	0	3	0.24	....	0.24	10
11	65.98	77.1	52.1	25.0	29.8477	29.989	29 736	.253	.4562	72.2	56.2	S.W.	12.21	4.0	10	0	71	....	....	....	11
12	63.18	73.0	57.3	15.7	29.6732	29.753	29.612	.141	.4413	77.7	55 3	S.W.	14.79	7.7	10	2	50	0.02	....	0.02	12
SUNDAY........13	.....	65.0	53.7	11.3	......	......	......	......	......	....	....	S.W.	14.04	...	..	..	22	0.21	....	0.21	13 ....SUNDAY
14	59 65	67.8	53.0	14.8	29.7880	29.848	29 754	.094	.4092	80.8	53.2	N.	7.33	6.5	10	0	31	0.00	....	0.00	14
15	67.00	77.8	52.9	24.9	29.7120	29 813	29.604	.209	.4720	72.0	57.3	N.W.	12.67	2.7	7	0	78	0 00	....	0.00	15
16	64.23	72.1	56.0	16.1	29 8190	29 870	20.776	.094	.3275	54.3	47.2	N W.	13.71	3.3	7	0	85	0.00	....	0.00	16
17	63.82	71.8	56.8	15.0	29.8468	29.908	29.775	.133	.3420	57.8	48.3	S.W.	7.07	4.0	8	0	59	....	....	...	17
18	66.45	77.1	57.0	20.1	29.8445	29.926	29.786	.140	.3448	53.8	48.8	N.W.	9.92	1.5	5	0	91	....	....	....	18
19	65.83	75.3	53 5	21.8	29.8848	30.004	29.685	.319	.3807	60.2	51.2	S.W.	6.30	5 7	10	0	47	...	....	....	19
SUNDAY. 20	.....	63.0	48.1	14.9	......	......	......	......	......	....	...	N.W.	16.25	....	..	..	56	0.03	....	0.03	20..........SUNDAY
21	53.28	59.3	44.6	14.7	29.7047	29.748	29.671	.077	.3032	74.3	45 2	S.W.	23.05	7.2	10	0	36	0.09	....	0.09	21
22	62.40	72.6	51.0	21.6	29.7627	29 784	29.741	.043	.3427	62.0	48.7	S.W.	25.42	3.3	10	0	69	0.00	....	0 00	22
23	69.35	81.6	54.0	27 6	29.8073	29 848	29.769	.079	.4568	64.3	56.2	S.W.	19.17	3.0	10	0	85	0.03	....	0.03	23
24	69.65	76.2	65.5	10.7	29.7958	29.844	29.716	.128	.6237	86.0	65.0	S.W.	11.46	8.0	10	5	18	1.61	....	1.61	24
25	69.10	77.2	62.1	15.1	20.7057	29.776	29.670	.106	.5070	71.3	59 0	S.W.	18.71	5.7	10	0	74	0.00	....	0.00	25
26	57.58	63.2	52.8	10.4	29.9357	30.013	29.857	.156	.2560	54.0	40.8	N.W.	19.12	4.3	9	0	54	....	....	....	26
SUNDAY........27	....	69 3	51.4	17.9	......	......	......	......	......	....	....	W.	18.42	...	..	..	82	0.00	...	0.00	27....... ...SUNDAY
28	63.43	72.2	55.5	16.7	30.0000	39 046	29.961	.085	.4092	70.0	53 2	S.W.	16.33	2.8	6	0	68	0.13	....	0.13	28
29	63.50	71.6	52.7	18.9	29.9972	30 107	29.828	.279	.3968	68.2	52.2	N.E.	8.92	6.2	10	0	49	0.05	....	0.05	29
30	60.77	66.1	58.0	8.1	29.7407	29.780	29 679	.101	.5017	94.2	59.2	W.	7.80	8.8	10	3	0	0.63	....	0 63	30
31	......	....	....	....	......	......	......	......	......	....	....	....	....	....	..	..	..	.	....	....	31
Means......	61.21	69.08	52.96	16.12	29.8766	29.9462	29.8137	.1325	.3877	71.38	51.20	S 77 ° W	13.60	5.39	9.3	1.3	49.3	3.76	....	3.76	..........Sums.
23 Years means for and including this month	64.41	73.61	56.31	17.29	29.9047	......	......	.150	.4341	69.8		.	S 13.17	5.6	..	.	¶ 53.5	3.52	....	3.52	23 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S E.	S.	S.W.	W.	N.W.	CALM.
Miles	304	709	155	889	128	3822	1469	2315	
Duration in hrs..	36	73	22	81	14	251	90	153	
Mean velocity....	8 45	9 71	7.05	10.98	9.14	15.22	16.32	15.13	

Greatest mileage in one hour was 30, on the 4th, 21st and 22nd.

Greatest velocity in gusts 36 miles per hour on the 4th and 22nd.

Resultant mileage, 4638.
Resultant direction, S. 77° W.
Total mileage, 9791.
Average mileage per hour, 13.60.

* Barometer readings reduced to sea-level and temperature 32° Fahrenheit.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 16 years only. § 11 years only.

The greatest heat was 81°C on the 23rd; the greatest cold was 41.°5 on the 2nd, giving a range of temperature of 40°1 degrees.

Warmest day was the 24th. Coldest day was the 3rd. Highest barometer reading was 30.215 on the 8th. Lowest barometer was 29.604 on the 15th giving a range of 0.611 inches. Maximum relative humidity was 99 on the 30th. Minimum relative humidity was 37 on the 18th.

Rain fell on 20 days.

Auroras were observed on 1 night, on the 15th.

Lunar halo on the 11th.

Fog on 3 days—4th, 11th and 30th.

Thunderstorms on 13th, 24th and 28th.

ABSTRACT FOR THE MONTH OF JULY, 1897.

Meteorological Observations, McGill College Observatory, Montreal, Canada. Height above sea level, 187 feet, C. H. McLEOD, *Superintendent.*

DAY	THERMOMETER. Mean.	Max.	Min	Range.	BAROMETER. Mean.	§Max.	§Min.	Range.	†Mean pressure of vapor.	Mean relative humidity.	Dew Point.	WIND. General direction.	Mean velocity in miles per hour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	66.77	78.3	54.5	23.8	29.7452	29.791	29.681	.110	.4757	75 2	57.5	W.	7.67	4.2	9	0	84	0.29	....	0.29	1
2	70.22	79.0	58.7	20.3	29.7518	29.816	29.725	.091	5075	69 5	59 3	S W.	11 33	6.3	10	4	43	....	...	....	2
3	71.05	80.9	58.8	22.1	29 9677	30.013	29.879	.134	.6112	80 2	64 5	S. E.	6.42	3.3	10	0	92	....	....	....	3
SUNDAY........ 4	.....	87.5	65.3	22.2	......	.....		.....	......	....	..	S.	12.08	.	..	..	91	....	......	...	4..........SUNDAY
5	82.58	93.0	72.2	20.8	29.8972	29.955	29.810	.145	8678	78.0	74 7	S.W.	12.29	3.7	10	0	92	0 10	....	0 10	5
6	81..8	90.0	75.0	15.0	29 9573	30.015	29.893	122	.7556	71 0	70.5	N.W.	0.62	3.8	10	0	83	0.01	....	0.01	6
7	79.67	90.6	71.0	19 6	30 0862	30.125	30 061	.064	.5852	59 2	63.5	N.	6 50	0.5	2	0	99	...	....	....	7
8	82.13	92.0	71.0	21.0	29.9782	30.076	29.876	.200	.7017	65 0	68.7	S.W.	8.42	0 5	3	0	92	....	....	....	8
9	78.65	90.5	73.6	16.9	29 8455	29.913	29.771	.142	6823	69.3	67 5	S.W.	18.62	0 8	10	4	69	....	....	....	9
10	72.10	81.5	61.3	20.2	29.9130	29 994	29.799	.195	.5137	65.8	59.7	N.E.	13.08	2 8	10	0	95	....	....	....	10
SUNDAY........11	.....	88.0	67.7	20.3	.....	......	......	......	......	....	....	S.	15 25	..	..	..	49	0.88	...	0.88	11 ....SUNDAY
12	63.53	68.3	59.5	8.8	29.6678	29 743	29 599	144	.5232	89.5	60.5	N.E.	15.08	10.0	10	10	00	0 73	....	0.73	12
13	62.12	65.9	58.8	7.1	29.7180	29.755	29 702	.053	.5437	96 8	61 2	N.E.	11.92	10.0	10	10	00	0 63	..	0 63	13
14	67.78	77.2	60.5	16.7	29.7098	29.808	29 637	.171	.6062	89.3	64 3	S.W.	11.25	7.5	10	2	38	0.41		0.41	14
15	70 85	78.8	62.7	16.1	29.9400	30 007	29.864	.143	.5748	77 0	63.0	S.W.	17 37	3 2	10	0	89	0 01	....	0.01	15
16	74.02	83.3	64.8	18.5	30.0628	30 085	30 033	052	.6123	75.0	65.0	S W.	11.62	4 7	9	0	81	Trace	....	Trace	16
17	71.28	79.4	63.5	15.9	30.1707	30.212	30.122	090	.5633	74 0	62 2	N.E	6.75	5.5	10	1	75	....	....	....	17
SUNDAY. 18	....	81.5	62.7	18.8	......	......	......	......	.....	....	..	N.E.	5.75	....	..	..	83	.	....	....	18 ....SUNDAY
19	74.65	84.1	63.6	20.5	30.2667	30.343	30.199	.144	.6703	75.0	67 2	N E.	6.00	5.5	8	0	71	...	....	...	19
20	74.62	82.5	69 0	13.5	30.1048	30.197	30 022	.175	.6688	80 8	67.0	S.	8.21	7 5	10	0	13	0.02	....	0.02	20
21	75.42	82.8	66.1	16.7	29.9540	30.017	29.885	.132	.6910	79.5	68 0	S E.	6.25	3 2	10	0	74	Trace	....	Trace	21
22	73 17	82.7	69.1	13.6	29 8138	29 891	29.743	.148	.7257	89 3	69 5	S.E.	9.54	0.3	10	1	32	0.11	. .	0 11	22
23	73.65	81.5	67.2	14 3	29.6680	29 745	29.616	.129	.6613	80.5	66.8	S W.	7.87	6.8	10	3	56	0 02	....	0.02	23
24	67.03	74.1	63.3	10 8	29.6498	29.726	29 619	.107	.5977	90.2	64 2	N.	14.29	6.7	10	0	22	0.68	...	0.68	24
SUNDAY........25	....	74 0	61.5	12.5	......	.....	......	.....	......	....	....	N.E.	16.29	...	..	.	21	Trace	....	Trace	25..........SUNDAY
26	65.88	74.4	56.0	18.4	30.0353	30.062	30.011	.051	.4670	74 2	57 0	N.E.	11.92	1.7	4	0	90	...	....	....	26
27	65.45	74.6	56.5	18 1	30 0292	30 083	29 992	.091	.4097	66.8	53.5	S.E.	11.75	2.2	6	0	77		..	....	27
28	61.22	64.5	58.6	5.9	29.9633	29 979	29.946	.033	.4105	75 7	53 3	S.E	12.33	10.0	10	10	00	0.17	...	0.17	28
29	60.58	65.8	58.1	7.7	29.9163	29 940	29.897	.043	.4920	93.3	58 5	E.	8.55	9.7	10	8	00	0.26	....	0.26	29
30	64.90	71.8	59.0	12.8	29 8950	29.944	29 830	.114	.5485	86.0	60 7	N.E.	8.04	6 0	10	0	29	Trace	....	Trace	30
31	65.40	69.5	61.0	8.5	27.7662	29.839	29.717	.122	.5597	89.3	62.2	S.W.	13 50	8.0	10	0	14	0.10	....	0 10	31
Means........	70.96	79.61	63.57	16.04	29.9064	29.9657	29.8492	.1165	.5933	78.46	63.33	S 18¼° E	10.73	5.42	8.9	2.0	56.5	4.42	....	4.42	...............Sums.
23 Years means for and including this month	68.83	77.33	60.76	16 57	29.8948	......	......	.141	.5034	71.44			S 12.87	5.43	..	.	¶58.50	4.06	....	4.06	23 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction.......	N.	N.E.	E.	S E.	S.	S.W.	W.	N W.	CALM.
Miles	955	1957	371	955	768	2502	297	177	
Duration in hrs..	88	171	46	95	75	202	38	26	3
Mean velocity....	10.85	11.44	8.07	10.05	10.24	12.38	7.82	6.81	

Greatest mileage in one hour was 26, on the 9th.

Greatest velocity in gusts 36 miles per hour on the 9th.

Resultant mileage, 790.
Resultant direction, S. 18¼° E.
Total mileage, 7982.
Average velocity 10.73 m. p. h.

* Barometer readings reduced to sea-level and temperature 32° Fahrenheit.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 16 years only. ȣ 11 years only.

The greatest heat was 93°0 on the 5th: the greatest cold was 54.°5 on the 1st, giving a range of temperature of 38°5 degrees.

Warmest day was the 5th. Coldest day was the 29th. Highest barometer reading was 30.343 on the 19th. Lowest barometer was 29.599 on the 12th giving a range of 0.744 inches. Maximum relative humidity was 99 on the 1st, 13th, 14th. Minimum relative humidity was 40 on the 7th.

Rain fell on 19 days.

Auroras were observed on 1 night

Fog on 1 day—on 23rd.

Thunderstorms on 4 days—on 1st, 5th, 11th and 23rd.

ABSTRACT FOR THE MONTH OF AUGUST, 1897.

Meteorological Observations, McGill College Observatory, Montreal, Canada. Height above sea level, 187 feet, C. H. McLEOD, *Superintendent.*

DAY	THERMOMETER. Mean.	Max.	Min.	Range.	BAROMETER. Mean.	§Max.	§Min.	Range.	†Mean pressure of vapor.	Mean relative humidity.	Dew Point.	WIND. General direction.	Mean velocity in miles per hour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY....... 1	.....	73.3	61.0	12.3	......	......	......	....	......	....	..	N.E.	7.42	..	..	..	60	0.05	....	0.05	1..........SUNDAY
2	69.32	76.2	61.6	14.6	29.9925	30.015	29.980	.035	.5880	81.8	63.8	N.E.	5.37	3.0	6	0	57	...	..	....	2
3	72.60	80.6	66.0	14.6	30.0047	30.037	29.980	.057	.6293	79.0	65.7	S.W.	13.54	8.3	10	5	27	0.00	....	0.00	3
4	64.02	68.3	60.5	7.8	30.1342	30.165	30.067	.098	.4737	79.0	57.3	N.E.	9.50	8.5	10	5	11	0.11	......	0.11	4
5	67.33	75.7	58.0	17.7	30.1518	30.190	30.112	.078	.4242	64.2	54.3	N.E.	8.87	0.2	1	0	95	....	....	....	5
6	70.17	77.8	62.8	15.0	30.1005	30.134	30.050	.084	.4597	62.2	56.3	N.W.	11.17	2.2	6	0	76	....	....	....	6
7	71.00	81.5	57.4	24.1	30.0883	30.158	30.025	.133	.5127	66.8	59.2	S.W.	9.54	2.8	10	0	88	0.00	....	0.00	7
SUNDAY....... 8	.....	82.0	64.2	17.8	......	......	.	.....	......	....	....	S.W.	14.33	...	..	..	95	...	....	....	8..........SUNDAY
9	70.45	80.6	63.6	17.0	29.9143	29.907	29.864	.103	.5172	69.8	60.0	S.W.	10.54	3.7	10	0	85	...	...	....	9
10	67.82	77.3	58.9	18.4	29.8085	29.875	29.744	.131	.5488	81.0	61.7	N.E.	8.08	7.8	10	0	45	0.09	....	0.09	10
11	65.17	75.4	62.3	13.1	29.5870	29.693	29.514	.179	.5630	90.5	62.2	S.E.	13.00	9.3	10	6	00	0.23	....	0.23	11
12	64.65	72.7	60.1	12.6	29.6768	29.824	29.547	.277	.4337	71.7	55.2	N.W.	17.92	7.0	10	2	75	0.00	....	0.00	12
13	61.25	64.6	54.0	10.6	29.9068	29.984	29.827	.157	.4238	78.2	54.2	S.W.	12.92	6.3	10	0	39	0.00	....	0.00	13
14	64.12	69.1	58.6	10.5	29.9645	30.022	29.905	.117	.4202	70.7	54.2	N.E.	9.21	4.3	9	0	57	....	....	....	14
SUNDAY....... 15	.....	80.5	59.5	21.0	......	......	......	......	......	....	...	S.E.	12.33	...	..	..	47	0.25	....	0.25	15..........SUNDAY
16	70.40	79.0	64.5	14.5	29.6090	29.715	29.544	.171	.5887	80.0	63.5	S.W.	15.33	6.7	10	2	55	0.22	....	0.22	16
17	59.65	63.7	57.5	6.2	29.7115	29.849	29.577	.272	.4523	88.3	56.2	S.W.	17.67	8.0	10	2	00	0.24	....	0.24	17
18	62.02	69.0	53.4	15.6	29.9108	29.929	29.874	.055	.4193	76.5	54.2	S.	12.71	4.3	10	0	61	0.00	....	0.00	18
19	61.33	67.9	56.0	11.9	29.8747	29.891	29.865	.026	.4710	86.5	57.2	S.W.	13.25	7.2	10	0	05	0.10	....	0.10	19
20	57.95	63.0	53.3	9.7	29.9402	30.020	29.846	.174	.3663	77.0	50.3	S.W.	16.58	2.2	6	0	89	0.00	....	0.00	20
21	62.00	72.0	50.1	21.9	29.9750	30.044	29.901	.143	.3857	69.8	51.8	S.W.	19.50	0.3	4	0	97	....	....	....	21
SUNDAY....... 22	.....	64.6	46.3	18.3	......	......	......	......	......	....	....	S.W.	12.62	...	..	..	25	0.03	....	0.03	22..........SUNDAY
23	53.38	60.7	44.9	15.8	30.0583	30.136	29.991	.145	.2873	70.3	43.8	N.E.	7.91	3.0	7	0	76	....	....	....	23
24	54.52	59.7	48.8	10.9	29.8638	29.932	29.807	.125	.3943	91.9	52.0	N.	7.91	10.0	10	10	00	0.02	....	0.02	24
25	60.72	68.7	52.1	16.6	29.7448	29.850	29.664	.186	.5035	94.3	59.2	S.W.	10.96	8.8	10	6	11	0.54	....	0.54	25
26	60.83	67.3	55.0	12.3	29.9558	29.982	29.909	.073	.4123	77.7	53.7	S.W.	11.25	3.5	8	0	90	0.00	....	0.00	26
27	64.00	72.7	53.0	19.7	29.8165	29.962	29.715	.247	.4762	69.5	57.5	S.E.	14.17	3.7	10	0	49	0.02	...	0.02	27
28	64.63	72.1	61.3	10.8	29.8793	29.969	29.786	.183	.5140	84.2	59.5	S.W.	14.79	5.2	10	0	22	0.00	....	0.00	28
SUNDAY....... 29	.....	77.7	57.2	20.5	......	.....	......	.....	......	....	....	S.W.	17.61	.	..	..	91	....	....	....	29..........SUNDAY
30	62.87	70.4	58.1	12.3	29.9132	29.926	29.896	.030	.4160	73.0	54.0	S.W.	16.58	1.2	5	0	95	0.05	....	0.05	30
31	60.18	67.5	52.3	15.2	29.9650	29.987	29.936	.051	.3643	70.5	50.2	S.W.	16.25	1.0	5	0	56	....	....	...	31
Means..........	63.94	71.99	57.17	14.82	29.9057	29.9714	29.8433	.1281	.4633	77.09	56.42	S. 47° ½ W.	12.54	4.94	8.26	1.46	55.45	1.95	....	1.95	..............Sums.
23 Years means for and including this month......	66.59	75.17	58.61	16.30	29.9399	......	......	.134	.4800	73.18			ϑ 12.50	5.31		.	¶58.51	3.60	....	3.60	23 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction.......	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles	388	885	107	1107	664	4698	815	679	
Duration in hrs..	44	110	11	88	51	318	63	59	
Mean velocity....	8.82	8.05	9.73	12.58	13.02	14.77	12.94	11.51	

Greatest mileage in one hour was 27, on the 30th.

Greatest velocity in gusts 36 miles per hour on the 30th.

Resultant mileage, 4570.
Resultant direction, S. 47° ½ W.
Total mileage, 9343.

* Barometer readings reduced to sea-level and temperature 32° Fahrenheit.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 16 years only. ϑ 11 years only.

The greatest heat was 82°0 on the 8th; the greatest cold was 44°9 on the 23rd, giving a range of temperature of 37°1 degrees.

Warmest day was the 3rd. Coldest day was the 23rd. Highest barometer reading was 30.190 on the 5th. Lowest barometer was 29.514 on the 11th giving a range of 0.676 inches. Maximum relative humidity was 99 on the 25th. Minimum relative humidity was 49 on the 14th.

Rain fell on 21 days.

Auroras were observed on 2 nights on 20th and and 23rd.

Lunar halo on 1 night on 7th.

Lunar Corena on 3 nights on 12th, 15th and 19th.

Thunderstorms on 5 days—on 10th, 15th, 16th, 25th and 27th.

ABSTRACT FOR THE MONTH OF SEPTEMBER, 1897.

Meteorological Observations, McGill College Observatory, Montreal, Canada. Height above sea level, 187 feet, C. H. McLEOD, *Superintendent.*

DAY	THERMOMETER.				BAROMETER.				†Mean pressure of vapor.	‡Mean relative humidity.	Dew Point.	WIND.		SKY CLOUDED IN TENTHS.			Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	Mean.	Max.	Min	Range.	Mean.	§Max.	Min.	Range.				General direction.	Mean velocity in miles per hour	Mean	Max.	Min.					
1	63.72	72.7	54.7	18.0	30.0132	30.050	29.992	.058	.4277	72.3	54.5	S.W.	16.88	2.2	8	0	94	....	....	....	1
2	60 32	68.9	54.4	14.5	30 1350	30.254	30 022	.232	.3453	60.8	48.8	N.W.	12.63	2 8	7	0	81	....	...	....	2
3	55.53	63 4	48.5	14 9	30.3523	30.376	30.296	.080	3060	70 2	45.5	N.W.	9.29	2 2	8	0	79	...	....	....	3
4	56 08	64 7	47.8	16.9	30 3265	30 404	30.227	.177	.3813	85 3	51.3	S.W.	9 04	3 7	10	0	33	0.00	......	0.00	4
SUNDAY....... 5	.....	76.8	52.4	24 4	......	.....	.....	.....	......	....	....	S.W.	23.67	...	..	..	96	....	....	...	5.............SUNDAY
6	69.13	82.2	59 5	20.7	30 1672	30.300	30.061	.239	.4917	68 5	58.0	W.	16.08	0.5	2	0	85	....	....	....	6
7	57.33	64.6	50.0	14.6	30.3283	30 421	30.225	.196	.3513	74.3	49.2	N.	9.71	4 7	10	0	34	0.02	....	0.02	7
8	68.07	78.6	55.8	22.8	30 0603	30.187	29 965	.222	.5745	82.5	62.5	S W.	14.75	3 2	10	0	55	0.01	....	0.01	8
9	74 43	83.2	65 6	17 6	29.9635	30 005	29.931	.074	6473	75.8	66.3	S.W.	22 63	0 2	1	0	89	....	...	....	9
10	77.72	86.8	69.9	16.9	29 9618	29 995	29 921	.074	.6838	71 5	68.0	S.W.	21.25	3.3	8	0	79	0.02	....	0.02	10
11	62 33	74.5	52.5	22.0	30.1637	30.253	30.063	.220	3795	58.0	47 2	N.	13.00	5.0	10	0	47	0.00	....	0.00	11
SUNDAY.......12	....	65.0	44.8	20.2	......	......	......	....	......	....	....	N.E	9.96	....	..	..	82	0.03	....	0.03	12 ....SUNDAY
13	64.68	74 8	56 6	18.2	29.8470	29.980	29.742	.238	.4775	77.2	57 2	S W.	17.42	6 5	10	1	33	0.26	..	0.26	13
14	56.45	62.2	52.5	0.7	30 1855	30 295	30 053	.242	.3315	72.8	47.7	W.	11.71	4.3	10	0	78	0 00	...	0.00	14
15	55 82	63.8	47.2	16.6	30 2430	30.345	30.127	.218	.3417	76.3	48.3	N	6.92	1.0	6	0	98	...	....	....	15
16	60 97	63.3	49.7	18.6	29 8970	30 099	29.729	.370	.4462	83.0	55 5	E.	10 13	5.3	10	0	29	0 03	....	0 03	16
17	56.90	64.7	45.6	19 1	29.9040	30 023	29.756	.264	.3428	72 0	47.3	N.W.	15.68	3.8	10	0	86	0.02	....	0 02	17
18	48.75	56.1	41.3	14.8	29 8803	30.015	29 729	.286	.2392	68.8	39.0	S.	11.54	6 5	10	0	17	0.00	....	0.00	18
SUNDAY 19	.... .	65.1	50.4	14.7	.....	......	......	......	......	....	....	S.	14.63	. .	.	..	25	0.13	....	0.13	19 ....SUNDAY
20	46.10	49.3	42.6	6.7	30 0723	30 091	30 036	.055	.2608	84.2	41.7	N.	12.75	9.7	10	4	0	0.38	....	0.38	20
21	46.32	51.8	40.3	11.5	30.1378	30.205	30 077	.128	.2105	67.2	35 7	S W.	17.38	1.5	8	0	96	....	....	....	21
22	51.40	59.5	42.7	16.8	30.2672	30 287	30 239	.048	.2845	75.2	43.7	N.	10 67	5 8	10	0	28	0.00	....	0 00	22
23	54.73	63.5	45.0	18.5	30.2077	30 291	30 110	.181	.3235	76 2	47.0	N.	7.17	4.5	10	0	76	....	....	....	23
24	56.30	62.5	50.5	12.0	29.9678	30.047	29.905	.142	.3782	83 7	51.2	N.	9.92	0.3	10	0	0	0.00	....	0.00	24
25	61.77	70.9	51.5	19.4	29 9723	30 020	29.918	.102	.4187	76.0	53.8	S W.	22.46	0 0	0	0	93	....	....	...	25
SUNDAY........26	.....	66.9	46.0	20 9	......	.....	......	....	......	....	....	S W.	19.46	...	..	..	4	0.24	....	0.24	26..........SUNDAY
27	42.98	47.7	39 4	8.3	30.0958	30 195	29.981	.214	.1913	68.8	33.7	S.W.	22.87	4 8	10	0	36	0.01	...	0 01	27
28	46.17	56 0	35 5	20.9	30.2287	30.290	30 166	.124	.1813	59.5	32.0	S W.	19.92	0 0	0	0	97	....	....	....	28
29	50.10	55 2	43.8	11.4	30.2760	30 317	30.242	.075	.2485	68.2	39.8	S.W.	11.08	7 8	10	5	24	0.00	....	0.00	29
30	58.68	69.4	44.2	25.2	30.1225	30 237	29.992	.245	.3707	74.2	50.2	S.W.	18.21	0 8	4	0	86	....	....	....	30
31	.....	....	....	....	......	......	.....	.....	......	....	....	......	......	....		..		....	....	....	31
Means..........	57.80	66.24	49.36	16.88	30.1072	30.1924	30.0193	.1731	.3687	73 40	49.04	S. 63½ W.	14 61	3.71	7.8	0.4	59.23	1.15	....	1.15	...............Sums.
23 Years means for and including this month	58.49	66.56	50.70	15 87	30.0144	......	......	.180	.3744	75.5			S 12.64	5.41	.	.	¶54 32	3.05	....	....	23 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction.......	N.	N.E.	E.	S E.	S.	S.W.	W.	N.W.	CALM.
Miles	1217	94	202	311	966	5469	699	1558	
Duration in hrs..	132	16	21	30	66	298	47	110	
Mean velocity....	9.22	5.88	9.62	10.37	14.64	18.35	14.87	14.16	

Greatest mileage in one hour was 33, on the 5th.

Greatest velocity in gusts 36 miles per hour on the 5th, 27th and 30th.

Resultant mileage, 5838.
Resultant direction, S. 63½ W.
Total mileage, 10,516.
Average velocity, 14.61 m. p. h.

* Barometer readings reduced to sea-level and temperature 32° Fahrenheit.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 16 years only. *s* 11 years only.

The greatest heat was 86°8 on the 10th; the greatest cold was 35°.5 on the 28th, giving a range of temperature of 51.3 degrees.

Warmest day was the 10th. Coldest day was the 27th. Highest barometer reading was 30.421 on the 7th. Lowest barometer was 29.640 on the 26th giving a range of .781 inches. Maximum relative humidity was 98 on the 13th. Minimum relative humidity was 40 on the 28th.

Rain fell on 18 days.

Lunar Coronas on 8 nights.

Thunder storms on 10th, 13th and 26th.