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THE

CANADIAN

Naturalist & Geologist,

AND PROCEEDINGS OF THE

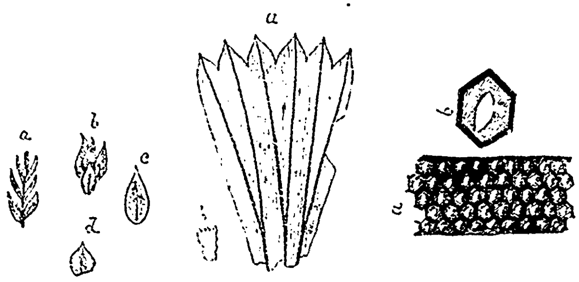
NATURAL HISTORY SOCIETY

OF MONTREAL.

CONDUCTED BY A COMMITTEE OF THE NATURAL HISTORY SOCIETY.

Vol. VII. AUGUST, 1862. No. 4.

(*Published September 19, 1862.*)



Montreal:
DAWSON BROS., No. 23, GREAT ST. JAMES STREET;
BAILLIERE BROS., LONDON, PARIS AND NEW YORK.

PRINTED BY JOHN LOVELL, MONTREAL.

Price Three Dollars per Annum, in Advance.

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ARTICLE XXII.—*A Lecture on Force, delivered before the Royal Institution of Great Britain on the 6th of June, 1862, by* PROF. JOHN TYNDAL, F.R.S.*

The existence of the International Exhibition suggested to our Honorary Secretary the idea of devoting the Friday evenings after Easter of the present year to discourses on the various agencies on which the material strength of England is based. He wished to make iron, coal, cotton, and kindred matters, the subjects of these discourses; opening the series by a discourse on the Great Exhibition itself; and he wished me to finish the series by a discourse on Force in general. For some months I thought over the subject at intervals, and had devised a plan of dealing with it; but three weeks ago I was induced to swerve from this plan for reasons which shall be made known towards the conclusion of the discourse.

We all have ideas more or less distinct regarding force; we know in a general way what muscular force means, and each of us would less willingly accept a blow from a pugilist than have his ears boxed by a lady. But these general ideas are not now sufficient for us; we must learn how to express numerically the exact mechanical value of the two blows; this is the first point to be cleared up.

* From the L. E. and D. Philosophical Magazine for July, 1862.

[A sphere of lead weighing one pound was suspended at a height 16 feet above the theatre floor. It was liberated, and fell by gravity. The weight required exactly a second to fall to the earth from that elevation; and the instant before it touched the earth, it had a velocity of 32 feet a second. That is to say, if at that instant the earth were annihilated, and its attraction annulled, the weight would proceed through space at the uniform velocity of 32 feet a second.]

Suppose that instead of being pulled down by gravity, the weight is cast upward in opposition to the force of gravity, with what velocity must it start from the earth's surface in order to reach a height of 16 feet? With a velocity of 32 feet a second. This velocity imparted to the weight by the human arm, or by any other mechanical means, would carry the weight up to the precise height from which it had fallen.

Now, the lifting of the weight may be regarded as so much mechanical work. I might place a ladder against a wall, and carry the weight up a height of 16 feet; or I might draw it up to this height by means of a string and pulley, or I might suddenly jerk it up to a height of 16 feet. The amount of work done in all these cases, as far as the raising of the weight is concerned, would be absolutely the same. The absolute amount of work done depends solely upon two things: first of all, on the quantity of matter that is lifted; and secondly, on the height to which it is lifted. If you call the quantity or mass of matter m, and the height through which it is lifted h, then the product of m into h, or mh, expresses the amount of work done.

Supposing, now, that instead of imparting a velocity of 32 feet a second to the weight, we impart twice this speed, or 64 feet a second. To what height will the weight rise? You might be disposed to answer, "*To twice the height*:" but this would be quite incorrect. Both theory and experiment inform us that the weight would rise to four times the height; instead of twice 16, or 32 feet, it would reach four times 16, or 64 feet. So also, if we treble the starting velocity, the weight would reach nine times the height; if we quadruple the speed at starting, we attain sixteen times the height. Thus, with a velocity of 128 feet a second at starting, the weight would attain an elevation of 256 feet. Supposing we augment the velocity of starting seven times, we should raise the weight to 49 times the height, or to an elevation of 784 feet.

Now the work done—or, as it is sometimes called the *mechanical effect*—as before explained, is proportional to the height, and as a double velocity gives four times the height, a treble velocity nine times the height, and so on, it is perfectly plain that the mechanical effect increases as the square of the velocity. If the mass of the body be represented by the letter m, and its velocity by v, then the mechanical effect would be represented by $m v^2$. In the case considered, I have supposed the weight to be cast upward, being opposed in its upward flight by the resistance of gravity; but the same holds true if I send the projectile into water, mud, earth, timber, or other resisting material. If, for example, you double the velocity of a cannon-ball, you quadruple its mechanical effect. Hence the importance of augmenting the velocity of a projectile, and hence the philosophy of Sir William Armstrong in using a 50 pound charge of powder in his recent striking experiments.

The measure then of mechanical effect is the mass of the body multiplied by the square of its velocity.

Now, in firing a ball against a target, the projectile, after collision, is often found hissing hot. Mr. Fairbairn informs me that in the experiments at Shoeburyness it is a common thing to see a flash of light, even in broad day, when the ball strikes the target. And if I examine my lead weight after it has fallen from a height, I also find it heated. Now, here experiment and reasoning lead us to the remarkable law that the amount of heat generated, like the mechanical effect, is proportional to the product of the mass into the square of the velocity. Double your mass, other things being equal, and you double your amount of heat; double your velocity, other things remaining equal, and you quadruple your amount of heat. Here then we have common mechanical motion destroyed and heat produced. I take this violin bow and draw it across this string. You hear the sound. That sound is due to motion imparted to the air, and to produce that motion a certain portion of the muscular force of my arm must be expended. We may here correctly say, that the mechanical force of my arm is converted into music. And in a similar way we say that the impeded motion of our descending weight, or of the arrested cannon-ball is converted into heat. The mode of motion changes, but it still continues motion; the motion of the mass is converted into a motion of the atoms of the mass; and these small motions communicated to the nerves, produce the sensation which we call heat. We, moreover, know the amount of heat which a given amount of mechanical force can develope. Our lead ball, for example, in falling to the earth generated a quantity of heat sufficient to raise the temperature of its own mass three-fifths of a Fahrenheit degree. It reached the earth with a velocity of thirty-two feet a second, and forty times this velocity would be a small one for a rifle bullet. Multiplying three-fifths by the square of forty we find that the amount of heat developed by collision with the target would, if wholly concentrated in the lead, raise its temperature 960 degrees. This would be more than sufficient to fuse the lead. In reality, however, the heat developed is divided between the lead and the body against which it strikes; nevertheless, it would be worth while to pay attention to this point, and to ascertain whether rifle bullets do not, under some circumstances, show signs of fusion.

From the motion of sensible masses, by gravity and other means, the speaker passed to the motion of atoms towards each other by chemical affinity. A collodion balloon, filled with a mixture of chlorine and hydrogen, was hung in the focus of a parabolic mirror, and in the focus of a second mirror, twenty feet distant, a strong electric light was suddenly generated. The instant the light fell upon the balloon the atoms within it fell together with explosion, and hydrochloric acid was the result. The burning of charcoal in oxygen is an old experiment, but it has now a significance beyond what it used to have; we now regard the act of combination on the part of the atoms of oxygen and coal, exactly as we regard the clashing of a falling weight against the earth. And the heat produced in both cases is referable to a common cause. This glowing diamond, which burns in oxygen as a star of white light, glows and burns in consequence of the falling of the atoms of oxygen against it. And could we measure the velocity of the atoms when they clash, and could we find their number and weight, multiplying the mass of each atom by the square of its velocity, and adding all together, we should get a number representing the exact amount of heat developed by the union of the oxygen and carbon.

Thus far we have regarded the heat developed by the clashing of sensible masses and of atoms. Work is expended in giving motion to these atoms or masses, and heat is developed. But we reverse this process daily, and by the expenditure of heat execute work. We can raise a weight by heat; and in this agent we possess an enormous store of mechanical power. This pound of coal, which I hold in my hand, produces by its combination with oxygen an amount of heat, which, if mechanically applied, would suffice to raise a weight of one hundred lbs. to a height of twenty miles above the earth's surface. Conversely, one hundred pounds falling from a height of twenty miles, and striking against the earth, would generate an amount of heat equal to that developed by the combustion of a pound of coal. Wherever work is done by heat, heat disappears. A gun which fires a ball is less heated than one which fires blank cartridge. The quantity of heat communicated to the boiler of a working steam-engine is greater than which could be obtained from the re-condensation of the steam after it had done its work; and the amount of work performed is the exact equivalent of the amount of heat lost. Mr. Smyth informed us in his interesting discourse, that we dig annually 84 millions of tons of coal from our pits. The amount of mechanical force represented by this quantity of coal seems perfectly fabulous. The combustion of a single pound of coal, supposing it to take place in a minute, would be equivalent to the work of 300 horses; and if we suppose 108 millions of horses working day and night, with unimpaired strength, for a year, their united energies would enable them to perform an amount of work just equivalent to that which the annual produce of our coal-fields would be able to accomplish.

Comparing with ordinary gravity the energy of the force with which oxygen and carbon unite together, the chemical affinity seems almost infinite. But let us give gravity fair play: let us permit it to act throughout its entire range. Place a body at such a distance from the earth that the attraction of the earth is barely sensible, and let it fall to the earth from this distance. It would reach the earth with a final velocity of 36,747 feet in a second; and on collision with the earth the body would generate about twice the amount of heat generated by the combustion of an equal weight of coal. We have stated that by falling through a space of sixteen feet, our lead bullet would be heated three-fifths of a degree; but a body falling from an infinite distance has already used up 1,299,999 parts out of 1,300,000 of the earth's pulling power, when it has arrived within 16 feet of the surface; in this space only $\frac{1}{1300000}$ths of the whole force is exerted.

Let us now turn our thoughts for a moment from the earth towards the sun. The researches of Sir John Herschel and Mr Pouillet have informed us of the annual expenditure of the sun as regards heat; and by an easy calculation we ascertain the precise amount of the expenditure which falls to the share of our planet. Out of 2300 million parts of light and heat the earth receives one. The whole heat emitted by the sun in a minute would be competent to boil 12,000 millions of cubic miles of ice-cold water. How is this enormous loss made good? Whence is the sun's heat derived, and by what means is it maintained? No combustion, no chemical affinity with which we are acquainted would be competent to produce the temperature of the sun's surface. Besides, were the sun a burning body merely, its light and heat would assuredly speedily come to an end. Supposing it to be a solid globe of coal, its combustion would only cover 4600 years of expenditure. In this short time it would burn itself out. What agency can then produce the temperature and maintain the outlay? We have already regarded the case of a body falling from a great distance towards the earth, and found that the heat generated by its collision would be twice that produced by the combustion of an equal weight of coal. How much greater must be the heat developed by a body falling towards the sun! The maximum velocity with which a body can strike the earth is about seven miles in a second; the maximum velocity with which it can strike the sun is 390 miles in a second. And as the heat developed by the collision is proportional to the square of the velocity destroyed, an asteroid falling into the sun with the above velocity, would generate about 10,000 times the quantity of heat generated by the combustion of an asteroid of coal of the same weight. Have we any reason to believe that such bodies exist in space, and that they may be raining down upon the sun? The meteorites flashing through the air are small planetary bodies, drawn by the earth's attraction, and entering our atmosphere with planetary velocity. By friction against the air they are raised to incandescence, and caused to emit light and heat. At certain seasons of the year they shower down upon us in great numbers. In Boston 240,000 of them were observed in nine hours. There is no reason to suppose that the planetary system is limited to "vast masses of enormous weight;" there is every reason to believe that space is stocked with smaller masses, which obey the same laws as the large ones. That lenticular envelope which surrounds the sun, and which is known to astronomers as the zodiacal light, is probably a cloud of meteors; and moving, as they do, in a resisting medium they must continually approach the sun. Falling into it, they would be competent to produce the heat observed, and this would constitute a source from which the annual loss of heat would be made good. The sun, according to this hypothesis, would be continually growing larger; but how much larger? Were our moon to fall into the sun it would develope an amount of heat sufficient to cover one or two years' loss; and were our earth to fall into the sun a century's loss would be made good. Still, our moon and our earth, if distributed over the surface of the sun, would utterly vanish from perception. Indeed, the quantity of matter competent to produce the necessary effect would, during the range of history, produce no appreciable augmentation in the sun's magnitude. The augmentation of the sun's attractive force would be more appreciable. However this hypothesis may fare as a representant of what is going on in nature, it certainly shows how a sun might be formed and maintained by the application of known thermo-dynamic principles.

Our earth moves in its orbit with a velocity of 68,040 miles an hour. Were this motion stopped, an amount of heat would be developed sufficient to raise the temperature of a globe of lead of the same size as the earth, 384,000° of the centigrade thermometer. It has been prophesied that "the elements shall melt with fervent heat." The earth's own motion embraces the conditions of fulfilment; stop that motion, and the greater part, if not the whole of her mass, would be reduced to vapour. If the earth fell into the sun, the amount of heat developed by the shock would be equal to that developed by the combustion of 6435 earths of solid coal.

There is one other consideration connected with the permanence of our present terrestrial conditions, which is well worthy of our attention. Standing upon one of the London bridges, we observe the current of the Thames reversed, and the water poured upward twice a-day. The water thus moved, rubs against the river's bed and sides, and heat is the consequence of this friction. The heat thus generated is in part radiated into space, and then lost, as far as the earth is concerned. What is it that supplies this incessant loss? The earth's rotation. Let us look a little more closely at the matter. Imagine the moon fixed, and the earth turning like a wheel from west to east in its diurnal rotation. Suppose a high mountain on the earth's surface; on approaching the moon's meridian, that mountain is, as it were, laid hold of by the moon, and forms a kind of handle by which the earth is pulled more quickly round. But when the meridian is passed, the pull of the moon on the mountain would be in the opposite direction, it now tends to diminish the velocity of rotation as much as it previously augmented it; and thus the action of all fixed bodies on the earth's surface is neutralized. But suppose the mountain to lie always to the east of the moon's meridian, the pull then would be always exerted against the earth's rotation, the velocity of which would be diminished in a degree corresponding to the strength of the pull. The tidal wave occupies this position—*it lies always to the east of the moon's meridian*, and thus the waters of the ocean are in part dragged as a brake along the surface of the earth; and as a brake they must diminish *the velocity of the earth's rotation.* The diminution, though inevitable, is, however, too small to make itself felt within the period over which observations on the subject extend. Supposing, then, that we turn a mill by the action of the tide, and produce heat by the friction of the millstones; that heat has an origin totally different from the heat produced by another mill which is turned by a mountain stream. The former is produced at the expense of the earth's rotation; the latter at the expense of the sun's radiation.

The sun, by the act of vaporisation, lifts mechanically all the moisture of our air. It condenses and falls in the form of rain, —it freezes and falls as snow. In this solid form it is piled upon the Alpine heights, and furnishes materials for the glaciers of the Alps. But the sun again interposes, liberates the solidified liquid, and permits it to roll by gravity to the sea. The mechanical force of every river in the world, as it rolls towards the ocean, is drawn from the heat of the sun. No streamlet glides to a lower level without having been first lifted to the elevation from which it springs, by the mighty power of the sun. The energy of winds is also due entirely to the sun; but there is still another work which he performs, and his connection with which is not so obvious. Trees and vegetables grow upon the earth, and when burned they give rise to heat, and hence to mechanical energy. Whence is this power derived? You see this oxyd of iron, produced by the falling together of the atoms of iron and oxygen; here also is a transparent gas which you cannot now see—carbonic acid gas—which is formed by the falling together of carbon and oxygen. These atoms thus in close union resemble our lead weight while resting on the earth; but I can wind up the weight and prepare it for another fall, and so these atoms can be wound up, separated from each other, and thus enabled to repeat the process of combination. In the building of plants carbonic acid is the material from which the carbon of the plant is derived; and the solar beam is the agent which tears the atoms asunder, setting the oxygen free, and allowing the carbon to aggregate in woody fibre. Let the solar rays fall upon a surface of sand; the sand is heated, and finally radiates away as much heat as it receives; let the same beams fall upon a forest, the quantity of heat given back is less than the forest receives, for the energy of a portion of the sunbeams is invested in building up the trees, in the manner indicated. Without the sun the reduction of the carbonic acid cannot be effected, and an amount of sunlight is consumed exactly equivalent to the molecular work done. Thus trees are formed; thus the cotton, on which Mr. Bazley discoursed last Friday, is formed. I ignite this cotton, and it flames; the oxygen again unites with its beloved carbon; but an amount of heat equal to that which you see produced by its combustion was sacrificed by the sun to form that bit of cotton.

But we cannot stop at vegetable life, for this is the source, mediate or immediate, of all animal life. The sun severs the carbon from its oxygen; the animal consumes the vegetable thus formed, and in its arteries a reunion of the severed elements takes place, and produces animal heat. Thus, strictly speaking, the process of building a vegetable is one of winding up; the process of building an animal is one of running down. The warmth of our bodies, and every mechanical energy which we exert, trace their lineage directly to the sun. The fight of a pair of pugilists, the motion of an army, or the lifting of his own body up mountain slopes by an Alpine climber, are all cases of mechanical energy drawn from the sun. Not, therefore, in a poetical, but in a purely mechanical sense, are we children of the sun. Without food we should soon oxidise our own bodies. A man weighing 150 lbs. has sixty-four lbs. of muscle; but these, when dried, reduce themselves to fifteen lbs. During an ordinary day's work, for eighty days, this mass of muscle would be wholly oxidised. Special organs which do more work would be more quickly oxidised: the heart, for example, if entirely unsustained, would be oxidised in about a week. Take the amount of heat due to the direct oxidation of a given amount of food; a less amount of heat is developed by this food in the working animal frame, and the missing quantity is the exact equivalent of the mechanical work which the body accomplishes.

I might extend these considerations; the work, indeed, is done to my hand—but I am warned that I have kept you already too long. To whom, then, are we indebted for the striking generalisations of this evening's discourse? All that I have laid before you is the work of a man of whom you have scarcely ever heard. All that I have brought before you has been taken from the labors of a German physician, named Mayer. Without external stimulus, and pursuing his profession as town physician in Heilbronn, this man was the first to raise the conception of the interaction of natural forces to clearness in his own mind. And yet he is scarcely ever heard of in scientific lectures, and even to scientific men his merits are but partially known. Led by his own beautiful researches, and quite independent of Mayer, Mr. Joule published his first paper on the "Mechanical Value of Heat," in 1843; but in 1842 Mayer had actually calculated the mechanical equivalent of heat from data which a man of rare originality alone could turn to account. From the velocity of sound in air Mayer determined the mechanical equivalent of heat. In 1845 he published his Memoir on "Organic Motion," and applied the mechanical theory of heat in the most fearless and precise manner to vital processes. He also embraced the other natural agents in his chain of conservation. In 1853 Mr. Waterston proposed, independently, the meteoric theory of the sun's heat, and in 1854, Professor William Thomson applied his admirable mathematical powers to the development of the theory; but six years previously, the subject had been handled in a masterly manner by Mayer, and all that I have said on this subject has been derived from him. When we consider the circumstances of Mayer's life, and the period at which he wrote, we cannot fail to be struck with astonishment at what he has accomplished. Here was a man of genius working in silence, animated solely by a love of his subject, and arriving at the most important results, some time in advance of those whose lives were entirely devoted to Natural Philosophy. It was the accident of bleeding a feverish patient at Java in 1840, that led Mayer to speculate on these subjects. He noticed that the venous blood in the tropics was of a much brighter red than in colder latitudes, and his reasoning on this fact led him into the laboratory of natural forces, where he has worked with such signal ability and success. Well, you will desire to know what has become of this man. His mind gave way; he became insane, and he was sent to a lunatic asylum. In a biographical dictionary of his country it is stated that he died there; but this is incorrect. He recovered; and, I believe, is at this moment a cultivator of vineyards in Heilbronn.

While preparing for publication my last course of lectures on Heat, I wished to make myself acquainted with all that Mayer had done in connection with this subject. I accordingly wrote to two gentlemen who above all others seemed likely to give me the information which I needed. Both of them are Germans, and both particularly distinguished in connection with the Dynamical Theory of Heat. Each of them kindly furnished me with the list of Mayer's publications, and one of them was so friendly as to order them from a bookseller, and to send them to me. This friend, in his reply to my first letter regarding Mayer, stated his belief that I should not find anything very important in Mayer's writings; but before forwarding the memoirs to me he read them himself. His letter accompanying the first of these papers, contains the following words:—"I must here retract the statement in my last letter, that you would not find much matter of importance in Mayer's writings: I am astonished at the multitude of beautiful and correct thoughts which they contain;" and he goes on to point out various important subjects, in the treatment of which Mayer had anticipated other eminent writers. My second friend, in whose own publications the name of Mayer repeatedly occurs, and whose papers containing these references were translated some years ago by myself, was, on the 10th of last month, unacquainted with the thoughtful and beautiful essay of Mayer's, entitled "Beiträge zur Dynamik des Himmels;" and in 1854, when Professor William Thomson developed in so striking a manner the meteoric theory of the sun's heat, he was certainly not aware of the existence of that essay, though from a recent number in *Macmillan's Magazine* I infer that he is now aware of it. Mayer's physiological writings have been referred to by physiologists—by Dr. Carpenter, for example—in terms of honourable recognition. We have hitherto, indeed, obtained fragmentary glimpses of the man, partly from physicists and partly from physiologists; but his total merit has never yet been recognised as it assuredly would have been had he chosen a happier mode of publication. I do not think a greater disservice could be done to a man of science, than to overstate his claims; such overstatement is sure to recoil to the disadvantage of him in whose interest it is made. But when Mayer's opportunities, achievements, and fate are taken into account, I do not think that I shall be deeply blamed for attempting to place him in that honourable position which I believe to be his due.

Here, however, are the titles of Mayer's papers, the perusal of which will correct any error of judgment into which I may have fallen regarding their author. "Bemerkungen über die Kräfte der unbelebten Natur," Liebig's Annalen, 1842, vol. 42, p. 231; "Die Organische Bewegung in ihrem Zusammenhange mit dem Stoffwechsel;" Heilbronn, 1845; "Beiträge zur Dynamik des Himmels," Heilbronn, 1848; "Bemerkungen über das Mechanische Equivalent der Wärme," Heilbronn, 1851.

ARTICLE XXIII.—*On the Utilisation of the Power involved in the Rise and Fall of the tides.**

The tendency of modern scientific discovery has been to show that all the various forms of force with which we are acquainted are mutually convertible into one another. Thus, of the six forces known to us in connection with the universe—gravitation, motion, light, heat, electricity, and chemical affinity—it is well known that any one of the five latter is capable, by appropriate means, of generating the other four, the force of gravitation being capable, through the medium of motion, of giving rise to the other five forces, whilst it cannot itself be generated. Gravitation may therefore be assumed to be the elemental force, since it is the only one of the six which will generate all the others. So accurately have these correlations been studied, that the quantitative value of gravitation has even been ascertained, it having been found that the mechanical force required to lift 772 pounds to the height of one foot, is capable, when converted into the force of heat, of raising the temperature of one pound of water 1° F. In other words, this amount of heat may be generated by an appropriate utilisation of the gravitating pull, exerted by a weight of 772 pounds during its downward movement through the space of one

* From the "Chemical News," 12th July, 1862.

foot. Supposing, therefore, we were in possession of an unlimited number of 772-pound weights, and were to employ in the most judicious manner the force thus evolved in their downward progress, we should have an unlimited reservoir of power which could be converted at will into light, heat, electricity, or chemical affinity, and could be made to toil for human benefit without any corresponding expenditure of human labour so long as the weights continued their downward progress unarrested. If, however, any good were to be gained by such a machine, it must be managed so that the motive force—gravitation—should always remain on the pull, and this is, and always will be, the obstacle to the attainment of perpetual motion; the act of overcoming the force of gravity to re-raise the weights, requiring the expenditure of exactly the same amount of power as has been generated during their downward fall; and so, before we can seriously discuss the feasibility of such a machine, we must find a perpetual flow of gravitating force always at hand, craving to be satisfied, and yet inexhaustible. In other words, we must construct a clock which will wind itself up when the weight has run down, without any expenditure of human power.

Sitting by the sea-shore a few days since, we could not help noticing the large reservoir of mechanical power existing in the ocean. We do not refer to the noisy dash of the waves as they break upon the beach, but to the infinitely mightier, although silent and progressive, energy exerted in the gradual rise and fall of the tides. Compared with the stupendous power capable of being utilised for man's benefit, and present in the rise or fall of millions upon millions of tons of water through a space of ten or twenty feet four times a-day, all the steam, water, or wind power in the world, together with the united muscular force of every living being, human and animal, sink into utter insignificance. We will try to form some idea of this power. Let us suppose that by the action of the tides the difference of level of the surface of the ocean at a certain spot, is 21 feet between high and low water; omitting for the present all consideration of the power of the subjacent liquid, what is the mechanical value of a space of 100 yards square of this water? 100 yards square by 21 feet deep equals 70,000 cubic yards of water, which are lifted to a height of 21 feet, or to 1,470,000 cubic yards lifted to a height of 1 foot. Now, since one cubic yard of water weighs about 1683 pounds, 1,470,000 cubic yards weighs 2,474,010,000 pounds, which is lifted in six hours. This is equivalent to lifting a weight of 412,335,000 foot-pounds in one hour; and since one horse-power is considered equivalent to raising 1,800,000 foot-pounds per hour, we have locked up in every 100 yards square of sea surface, a power equal to a 236 horse-power steam-engine, acting, be it remembered, day and night to the end of time, requiring no supervision, and costing nothing, after the first outlay, but the wear and tear of machinery.

By means of appropriate machinery connected with this tidal movement, any kind of work could be readily performed. Water could be hoisted, or air compressed to any desired extent, so as to accumulate power for future use, or for transport to distant stations. Light of surpassing splendor could be generated by means of magneto-electric machines: and with a very little exercise of ingenuity, every lighthouse on the coast could be illuminated with sun-like brilliancy, and with absolutely no expenditure of fuel; the very same mechanical power of the ocean, which in its brute force would dash the helpless vessel to pieces against the rocks, being bound and coerced like the genii in Eastern tales, and transformed by man's intellect into a luminous beacon to warn the mariner against the approach of danger.

ARTICLE XXIV.—*On the various theoretical views regarding the origin of the Primitive Formations.* Translated from the German of Carl Freidrich Naumann, (*Lehrbuch der Geognosie* II. 160), by THOMAS MACFARLANE.

The parallel structure, and the stratification of gneiss, mica-schist, etc., have, from the earliest dates of geological history, given rise to the opinion that water must, in some way or other, have had a part in the formation of these rocks. Werner and other geologists believed it to be even possible that they had been deposited from the waters of the ancient ocean, as crystalline sediments. But seeing that the mineralogical composition of the gneiss does not appear to be compatible with this view, geologists sought to explain the sedimentary origin of these rocks in a somewhat different manner. Thus, Von Beroldingen declared gneiss to be but a regenerated granite, that is to say, a rock resulting from granitic sand, washed together, in which the mica laminæ came to be deposited parallel with each other, among the grains of feldspar and quartz. The same view was later enunciated by Boué (Essai géologique sur l'Ecosse, p. 445), but afterwards again abandoned by him. Saussure, also, expressed himself in most decided opposition to Von Beroldingen's views. While narrating that Monte Rosa, from base to summit, consists of gneiss and rocks related to it, he says: "On ne dira donc plus, que les granites veinés, le gneiss et les autres roches de ce genre, ne sont que les débris des granits, rassemblés et agglutinés au pied des hautes montagnes."* Moreover, (in a note to § 2143 of the work just quoted), Saussure, otherwise mild and delicate in judging and confuting the opinions of others, deals very severely with Von Beroldingen's gneiss theory.†

Somewhat related to this old view is the supposition expressed more recently by Dana, that gneiss and mica-schist bear a relation to granite, similar to that in which basaltic tufa stands to basalt, or volcanic tufa to lava; the materials of these rocks (the gneiss and mica-schist) having been thrown up to the surface before and during the eruptions of the granite, in the form of sand-like ejections, and transformed into gneiss and mica-schist by the action of glowing hot water. The perfect and thoroughly crystalline character of the gneiss, the enormous extent which the primitive formations occupy in so many districts, the architecture of these great gneiss districts, and their occurrence totally independent of larger granitic masses, are all incompatible with this idea.

In certain respects the Huttonian theory, which afterwards became so influential, may be compared with that of Von Beroldingen's, since this celebrated Scottish geologist, in his Theory of the Earth in 1795, attempted, with much minuteness, to prove that the whole of the so-called primitive rocks had been formed of the débris of older preexisting rocks, deposited on the bed of the ocean; the strata, consisting originally of loose materials, having been, under the pressure of the ocean, exposed to a high temperature for a long time, in which manner their consolidation was effected.‡

* Voyage dans les Alpes, § 2139.

† Especially on account of Beroldingen asserting that the opponents of his theory were destitute of all geological knowledge, and saying that the circulation of their writings ought to be prohibited. Beroldingen's writings, Saussure thought it was altogether unnecessary to prohibit; "l'extrême désordre, l'intolérable diffusion, et les perpétuelles contradictions qui y règnent en dégouteraient assez le plus grand nombre des lecteurs."

‡ Compare Explication de Playfair sur la théorie de la terre, par Hutton, traduit par Basset. Paris, 1815.

At present there are especially two hypotheses maintained by different parties, regarding the origin of gneiss, and of the rocks associated with it. The first of these theories is founded on the notion of the metamorphism of rocks, and the second, on the theory of the originally fused condition of our planet.

The great majority of the geologists of the present day incline to the opinion that these oldest cryptogenous rocks, as wel as the recent formations resembling them, have been produced by a peculiar metamorphosis of preexisting sedimentary strata; consisting essentially in a recrystallisation of the materials of these strata, and caused either by a high temperature, or by molecular movements excited in some other way.

The supporters of this theory found it especially upon the parallel structure and stratification of these rocks, upon the indisputable fact that clay-slate in the neighborhood of large granite masses is frequently changed into mica-schist and rocks of a gneissoid character, and upon the scarcely doubtful fact that in many countries, gradual transitions may be followed, from gneiss, through mica-schist and clay-slate, into greywacke slate. By these transitions, gneiss is brought into such close connection with greywacke slate, that these appear only as the extreme members of a single series; for the whole of which one and the same original mode of formation must be assumed. Now since greywacke slate is undoubtedly a sedimentary rock, the clay-slate, mica-schist and gneiss lying under it, must have been something similar. But because the mineralogical composition and the crystalline nature of these deeper rocks appear the more opposed to this inference the deeper they lie, the disciples of the metamorphic theory were obliged to suppose the action of a metamorphism working from beneath, which has reacted upon, and so altered these oldest sedimentary strata, that they now appear as gneiss and mica-schist.

This theory, which at the first glance appears so satisfactory, was first enunciated by Boué in 1822, was afterwards adopted by many other geologists, and found in the year 1833 more decided expression through Lyell, who gave the strata thus altered the name of hypogenous metamorphic rocks; a title which is intended to indicate a metamorphosis which took place in the depths of the earth's crust, and proceeded from beneath upwards. Properly speaking, these views were very similar to those which Hutton attempted to establish in the years 1788 and 1795,* and his

* His Theory of the Earth appeared for the first time in the Edinburgh Philosophical Transactions for 1788.

commentator Playfair, in 1802; so that it is in reality possible to maintain that the present theory of the metamorphic origin of the primitive formations is only a farther development of the Huttonian theory. Boué however first understood how to bring this theory into more decided harmony with the details of geological phenomena, and besides making use of internal heat, brought emanations of gases and vapors out of the interior of the earth, to his assistance, in order to explain the alteration of sedimentary slates into gneiss and mica-schist. "La chaleur ignée," says he, "et les émanations gazeuses de l'intérieur de la terre auraient donné aux schistes, peu à peu, et sous une plus ou moins forte compression, une espèce de liquéfaction ignée, assez semblable à celle dont M. de Drée a fait mention dans ses belles expériences.* Les élemens des schistes auraient perdu de leur force de cohésion, leurs parties constituantes auraient été écartées les unes des autres, at les émanations gazeuses auraient pu s'insinuer dans les vides ainsi laissés. De cette manière les affinités chimiques auraient pu s'exercer dans certaines limites, posées par les forces adverses de la cohésion, et les parties constituantes des roches auraient pu prendre, pendant la liquéfaction et le refroidissement lent, un arrangement plus ou moins crystallin, suivant les circonstances, et sans déranger ou detruire notablement la structure feuilletée primitive. De plus, le jeu des affinités chimiques, aidée par les substances étrangères, introduites, pour ainsi dire, par sublimation, dans ces roches, aurait donné naissance à cette foule d'espèces minérales crystallines, qui sont disséminées dans nids, en amas, et en petits filons au milieu des schistes crystallins. Cette théorie hardie présente du moins incontestablement l'avantage d'expliquer tous les faits géologique d'une manière satisfaisante."†

Very many geologists agree with this theory in its principal features. Others, among whom may be especially mentioned Keilhau, Studer and Escher, think it doubtful that the metamorphosis has been accomplished by high temperature, and by vapors, and believe rather, that inward transforming processes may have come into operation at ordinary temperatures, whose

* De Drée described these experiments in the Journal des Mines, No. 139. The principal point to which Boué refers is that the melted or half-melted rocks preserved their texture, and the distribution of their constituent particles unchanged, as has also later been shown by Gerhard to be the case with granulite.

† Annales des Sciences Naturelles, 1824, Août, p. 417.

inferior energy may have been compensated for by their long duration. But while these philosophers do not express a decided opinion regarding the real character of these transforming processes, G. Bischof and Haidinger are inclined to suppose that a long continued percolation of water through the rocks* has produced a substantial alteration and recrystallization, in the same way as must have taken place in the production of certain alteration pseudomorphs.† Many believe it possible to indicate more nearly the sedimentary rocks from which these cryptogenous rocks have been produced. Thus, in 1833, Hitchcock was of opinion that the gneiss had probably been previously a coarse micaceous sandstone, a view which Durocher also adopted, while Forchhammer believed it possible to prove that the gneiss of Egeberg, near Christiana, was produced from the alum-schist, which occurs there.‡

We have already remarked however that parallel structure and stratification, cannot in every case, be considered as decisive proofs of sedimentary origin. Even Macculloch, in other respects a zealous supporter of the metamorphic theory, admits this. He says expressly that he is obliged to explain the parallelism of the laminæ of mica, so often adduced, as a proof of the sedimentary deposition of gneiss, in quite another manner, because even hypersthenite sometimes shows a parallel deposition of its crystals of hypersthene, and at Kerrera a trap which occurs in veins is, like mica slate, filled with scales of mica, all lying parallel with the sides of the vein.

We have also already mentioned the doubts brought forward by Hoffman and Riviere against the view that widely extended gneiss areas are to be considered as altered sedimentary masses. De

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* So early as the year 1785, Von Trebra enunciated the view that the alteration of whole mountain masses, for example, of granite into gneiss, and of greywacke into clay slate, had been caused by a very long continued process of alteration, which he characterised as a sort of fermentation, and which was produced essentially by the circulation of water, and by the action of heat. Since these causes, which although unperceived, are nevertheless thoroughly active, and still at work, and will continue, so as long as circulation goes on in the immeasurable round of nature, he is convinced that the alterations, decompositions and recompositions which they produce everywhere in the interior of the rocks will continue as long as the world itself.—(*Erfahrungen von Innern der Gebirge*, p. 48.)

† Lehrbuch der Phys. und Chem. Geologie, II. 247.

‡ Journal für Praktische Chemie. Bd. 36, 1845, S. 404.

la Beche expressed himself, even earlier, in the same manner as Riviere, and doubted whether the metamorphic theory (the sweeping hypothesis, as he called it) was admissible in such cases, although he quite acknowledges it within its proper limits (Report on the Geology of Cornwall, p. 34). With this, A. Erdmann, a high authority with regard to the Swedish primitive rocks, and Von Blöde, who has explored Finland in various directions, perfectly agree. Von Blöde says: that the metamorphism is undeniably present where it can be recognised by observation, and explained generally by physical science. Still the class of rocks with which this is the case, is only limited, and not at all favorable to the baseless hypothesis which is now being carried to extremes. (Neues Jahrbuch für Mineralogie, 1844, s. 53.) Von Leonhard, Petzholdt and others, have also repeatedly declared against the too wide extension of the metamorphic theory, and we are obliged, from complete conviction, to rank ourselves with them. The transitions from gneiss, through mica-schist, into crystalline clay-slate are not to be denied, but whether the transitions from crystalline clay-slate into real greywacke slate may pass, in every case, for fully proved, may still be doubted. Grüner remarks distinctly that the clay-slate which is associated with gneiss and mica-schist is always different from the clay-slate of the greywacke; for which reason he declares himself unable to assert that these older rocks, as they appear in the departments of the Rhone and Loire, are metamorphosed greywacke slates. (Ann. des Mines, 3ième série, t. 19, 1841, p. 70).

In our opinion the principal difficulty, and one scarcely to be overcome, lies in the fact that there are far younger gneisses mica-schists, etc., which overlie sedimentary rocks, without the slightest transition into these underlying rocks being observable. In such cases every idea must disappear relative to a hypogenous or anogenous metamorphosis; for how could the overlying rock have been metamorphosed by some agency from beneath, while the strata beneath remain unaffected by any influence. Just as little can a catogenous metamorphosis be thought of, for whatever cause one may suppose as the real agency, it is impossible that it can have found in descending, such a sudden and entire check, along one and the same plane of deposition, that the completely re-crystallised rock, should be, by this plane of deposition, separated from the perfectly unchanged rock. In such cases there is nothing left for us but the supposition that these stratified, crystalline, silicated rocks, have been originally formed, and deposited, in the state in which they now appear to us. If we are not able to comprehend the modality of their process of formation, we can comfort ourselves with the adherents of ultra-metamorphism, who are *quite* as much at a loss. After all, it is perhaps immaterial whether we assume a problematical process of alteration, or a problematical process of formation; but if we were, once for all, to choose between one of the two enigmas, we would probably rather prefer the latter, which at least is in unison with the state of the facts. A second objection against the too wide application of the metamorphic theory, arises out of the fact that many gneissoid rocks shew undoubted evidences of an eruptive origin, and that granulite also, which is so nearly related to gneiss, sometimes occurs under such circumstances as appear to demand for it an eruptive mode of formation. If this is really the case, it is a proof that certain cryptogenous rocks are decidedly not of metamorphic origin.

The great resemblance which gneiss and the most of the rocks accompanying it bear to granite and other eruptive rocks; the probability that the most of these eruptive rocks have been solidified from a state of igneous fluidity; the almost unavoidable assumption that our planet was originally in the same state, and was only later covered with a solidified crust; finally the fact that in the primitive gneiss formation, granite and gneiss are found regularly interstratified with each other, have called forth the second of the hypotheses prevailing at present; namely, that the primitive formations form the first solidified crust of our planet.

This hypothesis has not indeed found so many supporters* as that of the metamorphic origin of the primitive rocks, nevertheless the objections against it are probably neither greater nor more numerous than against the latter. It leads necessarily to

* The following geologists support this theory: Fleurian de Bellevue, (Journal de Physique, an XIII); Breislak, (Lehrbuch der Geol., I, 372); Cordier, in the third part of his celebrated treatise on the temperature of the interior of the earth, (Ann. des Mines 2, série II, p. 120); Marcel de Serres; Kapp, (Neues Jahrbuch für Min. 1834, 255, and 1843, 326); Von Blöde, *Neues Jahrbuch für Min.* 1837, 176; De la Beche, Report on the Geology of Cornwall, &c., 1839, p. 31; Petzholdt, Geologie, 1840, p. 24, and 1845, p. 35; de Roys, Bull. de la Soc. Géol. XIII, 1840, p. 240; Scheerer, Karsten and Von Dechen, Archiv. vol. 16, 1842, p. 159; Nöggerath, Entstehung der Erde, 1843; Cotta, Grundriss der Geognosie, 1846, p. 161; Rivière, Bull. de la Soc. Géol., 2 série VII, p. 327.

the inference that the succession of the primitive rocks in a downward direction, corresponds to their age from oldest to youngest, because it was, of course, through a solidification from the outside inwardly, that the strata in question were formed, (Lehrbuch I, 489). The only way of explaining the origin of the newer cryptogenous rocks, left to the supporters of this hypothesis, is to suppose that their material has been protruded from the interior through the earth's crust in an eruptive form.

The most considerable difficulties which this hypothesis has to contend with, arise from the relations of the structure of the primitive formations, and from the mineralogical character of certain of the rocks belonging to it. Whether these difficulties can be explained away by the supposition of a hydro-pyrogenous development of the outside part of the primitive solidified crust, as indicated by Angelot, Rozet, Fournet, Scheerer and others, we must leave undecided in the meantime. Scheerer attempted, in a peculiar manner, to overcome the difficulties which the structure and architecture of the gneiss present. He regards them as an original phenomenon, produced during the solidification itself, by the action of electro-magnetic currents; and comes to the final conclusion, "that the primitive formations, with all the diversity of their rocks, are only to be regarded as the first hardened crust of the solidifying earth." If the vertical position of the primitive gneiss strata, as displayed in their parallel-zoned, fan-shaped and gable-formed architecture, is really to be looked upon as their original position, then the verdict which Kittel thus expressed, must be pronounced correct: "so long as a hypothesis is unable thoroughly to explain the almost vertical position of the primitive strata, it cannot be regarded as even approximately near the truth." (Skizze der geogn. Verhältnisse von Aschaffenburg, p. 40).

Scheerer concludes from the contortions and undulations of the gneiss layers, that the primitive rocks must have originally been in a soft, plastic state, and Macculloch, even earlier, arrived at the same conclusion, from the surprising contortions of the mica-schist, which he compared with similar windings in the structure of certain basalts. There is probably nothing to be said against the correctness of this deduction, which receives complete confirmation from the so frequently occurring elongation of the constituent of gneiss and other primitive rocks. But whether this plastic condition has been occasioned by high temperature alone, or by the simultaneous action of heat and water, or only by the latter element, are questions whose solution we must still expect from the future. In the meantime the real mode in which the primitive rocks have been formed, is still involved in such obscurity, that they may, with complete justice, be termed cryptogenous rocks.

Note to the preceding paper; by T. Sterry Hunt, M.A., F.R.S.

The foregoing sketch of the progress of theoretical views as to the origin of the crystalline rocks, gives an excellent statement of the question up to 1857; since which time more definite notions as to the nature of the metamorphic process, as understood by Hutton and Boué, have begun to be entertained. The problem of rock metamorphism is the conversion of mechanical or chemical sediments into definite mineral species, by molecular changes; that is to say, by crystallization, and a re-arrangement of their particles; or by chemical reactions between the elements of the sediments. Pseudomorphism, which is the change of one mineral species into another, by the introduction, or the elimination of some element, presupposes metamorphism; since only the definite mineral species of metamorphic or plutonic rocks can be the subjects of this process. To confound metamorphism with pseudomorphism, as Bischoff, and others after him have done, is therefore an error. It may be further remarked, that, although certain pseudomorphic changes may take place in some mineral species, in veins, and near to the surface; the alteration of great masses of silicated rocks by such a process, is as yet an unproved hypothesis.

The study of the local metamorphism of sediments in the vicinity of intrusive rocks, goes far to show, in opposition to the opinions of some authors quoted above, that heat has been one of the necessary conditions of metamorphism. In 1857, I showed by experiments, that besides heat and moisture, certain chemical reagents might be requisite, and that water impregnated with alkaline carbonates or silicates, would at a temperature not above that of boiling water, produce chemical reactions among the elements of many sedimentary rocks; dissolving silica and generating various silicates. Some months subsequently, Daubrée found that in the presence of solution of alkaline silicates, at temperatures above 700° F., various silicious minerals, such as quartz, feldspar and pyroxene, could be made to assume a crystalline form; and that alkaline silicates, under these conditions, might combine with argillaceous matters to produce feldspar and mica. These observations were the complement of my own, and both together showed the agency of heated alkaline waters to be sufficient to effect the metamorphism of sediments, by the two modes just mentioned; namely, by molecular changes, and by chemical reactions.

Following upon this, Daubrée observed that the thermal spring at Plombières, at a temperature of 160° F., had, in the course of centuries, given rise to the formation of zeolites, and of various other crystalline silicated minerals, among the bricks and cement of the old Roman baths. From this, he was led to suppose that the metamorphism of great regions might have been effected by hot springs; which rising along certain lines of dislocation, and thence spreading laterally, might produce alteration in strata near to the surface; while those beneath would, in some cases, escape alteration. In this way, would be resolved the great difficulty urged by Naumann against the theory of metamorphism by heat from below; namely, that in descending, a certain plane, sometimes limits the metamorphism, and separates the altered strata above from the unaltered ones beneath, without any apparent transition between the two.

Daubrée's ingenious hypotheses of metamorphism by hot springs, in some instances meets this difficulty; but while undoubtedly true in certain cases of local alteration, it seems utterly inadequate to explain the complete and universal metamorphism of areas of sedimentary rocks, embracing many hundred thousands of square miles. On the other hand, the study of the origin and distribution of mineral springs, shows that the alkaline waters, whose action in metamorphism I first pointed out, and whose efficient agency Daubrée has so beautifully shown, are confined to certain sedimentary deposits, and to certain stratigraphical horizons; above and below which, waters totally unlike in character, are found impregnating the strata. This fact seems to offer a simple solution of the difficulty advanced by Naumann, and a complete explanation of the theory of metamorphism of deeply buried strata, by the agency of ascending heat; which is operative in producing chemical changes only in those strata in which soluble alkaline salts are present. See farther on this subject, the *Canadian Naturalist*, vol. iv. page 414; the *Quarterly Journal of the Geological Society of London*, for 1859, page 488; and the Report of the Geological Survey of Canada for 1853-56, page 477.

ARTICLE XXV.—*On Aphis Avenæ*. By GEORGE LAWSON, Ph., D., LL.D.

(*For the Canadian Naturalist*).

In my Report on the Insects affecting the Field Crops, &c., in Canada, during the season of 1861, notice was taken of the sudden appearance of the Wheat or Grain Aphis (not found to be identical with the *Aphis Avenæ* of Europe,) in alarming numbers on Wheat, Oats, Rye, &c. During the present season (1862) the insect has played over again the part which it took in 1861, and which created so much alarm among our farmers. They are better acquainted with the stranger now, knowing that he comes merely to suck the green juicy grain without the means of doing much mischief; but, having obviously become a permanent colonist, it is desirable that a few facts connected with his first appearance and settlement in our country should be placed on record in the *Canadian Naturalist*.

In the beginning of August, 1861, ears of wheat infested with this insect were transmitted to me by several farmers and others in the neighbourhood of Kingston, all of whom regarded the insect as a new pest to the country. The earliest examples were received from Professor Williamson, Portsmouth, John Duff, Esq., Princess Street, A. Drummond, Esq., Manager of the Montreal Bank, Messrs. Platt, Napanee, and from farmers in the neighbourhood of Odessa, and in Pittsburg. A few days afterwards reports were found in the newspapers of its appearance in various parts of Upper and Lower Canada, and over a considerable portion of the Northern States; all reports spoke of the insect as new and unknown to the farmers. More special enquiry among entomological friends and reference to published works, only served to confirm the surmise that there existed no record or tradition of its previous occurrence in our fields. Prof. Williamson, who had for many years observed with care the insects affecting the crops in this locality, had not previously seen this species of Aphis on any of the grains; numerous farmers of whom enquiries were made in different parts of the country knew nothing of the insect in former years. And, lastly, Dr. Asa Fitch, the able entomologist to the State of New York, whose keen eye has added so much to our knowledge of economic entomology, recognised in the Aphis a new vagabond whose photograph and antecedents required to be reported to the State authorities.

The insect is individually minute, like all the Aphides, but presents a formidable appearance on account of the vastness of its numbers. In some fields, a few days after its first appearance, the ears of grain became covered with it; in fact the wheat was commonly spoken of as "dark with it." The fly presented itself chiefly in the wingless form, the individuals clustering in great numbers in the upper parts of the culms and panicles of wheat, rye, oats and barley, and this season they have been observed on indian corn and various other grasses. Most of them are stationary, but some are usually moving about with a rather awkward motion resembling that of mites under a magnifying glass. On each panicle or head of grain they are found to be of various sizes, according to age, some scarcely large enough to be visible to the naked eye, others as large as the capital letters on this printed page. They vary in colour; some are pale apple-green, some of a brownish yellow colour, and many, especially the older and larger ones, are of a rather deep brick-red colour, when they become very conspicuous. In some cases where the whole ears were covered with the insects, the total destruction of the crops seemed to some of the farmers to be inevitable. They looked upon the "new bug plague" (for everything that looks like an insect is called a bug) as the greatest calamity that had ever befallen our fields. It was deemed advisable therefore to publish in the Kingston newspapers an account of the habits of the insect, with the view of allaying unnecessary fears. Attention was drawn to the following among other facts:—The aphides do not gnaw the plant's stem and leaves like caterpillars, nor like the wheat midge, injuriously affect the young grain, but simply suck the juices of the exposed parts of the plant. The plant necessarily suffers from this injury, its energies are weakened, the leaves and other parts shrivel and blister, and an inroad is formed for other diseases; but, while aphides are highly injurious to thin and succulent leaved plants, the compact tissue of wheat and other grains, hardened too by silica, is not so liable to suffer and become deformed, and a vigorous healthy crop of grain will hardly be injured. No doubt the yield is lessened by the presence of the insect in vast numbers, and the quality of the grain perhaps slightly deteriorated, but the injurious effects are by no means so extensive as the formidable appearance of the insects would indicate.

In Britain the bean crop is annually liable to the attacks of an allied black species (*Aphis Rumicis*) which appears in such numbers that in autumn when many of the individuals have acquired wings and left the bean fields, they spread over the country, darkening the atmosphere with living clouds,—yet the farmers do not find their bean crops very light, even during the worst seasons of this so called "cholera fly." Items of information and assurances such as the above served to allay the fears of the farmers, and to prevent unnecessary expenditure of time and money and probable injury to the crops in experimenting with the various remedial applications recommended in the public prints to stay the "insect plague," such as smearing the standing grain with gum arabic, pulverised hellebore, scotch snuff, flowers of sulphur, aloes and other substances, which, however obnoxious, they might have been to the aphis, would not have improved, by any means, the flavour of the grain and flour.

As the season advanced, the aphides increased in numbers, and were no longer confined to wheat, but became abundant and conspicuous on oats and rye. Daily parcels of grain ears were being received from various ports of the country from farmers who feared that, while entomologists were ferreting out the history of the insect, their crops would in the meantime be eaten up. In the counties of Frontenac, Lennox and Addington, the insect was universal. Wheat proved to be generally light; but the real damage seems to have been done by a less conspicuous but more destructive insect,—the wheat midge,—which was at work early in the season, and, being a sly rogue in grain, was probably not observed by many of the farmers, although quite common in the Kingston district.

As the season advanced, the insects preying upon the aphis seemed to increase; but the most marked effect was observed to result from the heavy rains of the night of Wednesday, 21st, and Thursday, 22d August, which very sensibly reduced the numbers of the aphis. Gardeners say that watering plants overhead rather encourages the production of aphides than otherwise. No doubt aphides like moisture, and especially a moist atmosphere. But it was long ago observed by my correspondent, Mr. Hardy, of Penmanshiel, who has devoted special attention to these insects, that heavy rains served to dispel them.

During the present season (1862) the aphis has again made its appearance, and in as great numbers as before. It has naturally attracted less notice, but appears to be widely diffused in all the cultivated parts of central Canada. In August, 1862, I traced it from Kingston, on the scattered farms along the Addington Road, back to the township of Olden, a distance of about fifty miles. When we consider that many of the farms referred to are mere isolated patches of clearing in the woods, widely separated from each other, in some cases by miles of interminable forest and swamp, we see that the diffusion of this insect is totally independent of its own limited locomotive powers. In its winged state it is no doubt carried in clouds by the winds, like the seeds of thistles and other winged plants.

In looking over a general collection of insects, one is struck with the large numbers of species peculiar to certain countries or districts, and which, in spite of their locomotive powers and other means of diffusion, seem to persist in adherence to circumscribed localities. The aphides are of a different character; those of them which infest cultivated plants may probably, with most truth, be regarded as cosmopolitan, having no special regulating influences that we know of beyond the supply of their food and *extremes* of climate. They are like the corn weeds that spring up wherever the cereal grains are cultivated, and whose original nativity has been lost. The careful observation of animals and plants of this character, in a new country where settlement is still progressing, is calculated to afford valuable information to the zoological and botanical geographer.

The wingless aphides found in such numbers during the summer are all females, but some of the females are winged. Remarkable as it may appear, it is nevertheless true, that the females have the power of bringing forth living young, without any intercourse of the sexes. This may be readily observed by enclosing one under a glass, and observing the production of new individuals, which is regarded by naturalists rather as the result of a process of budding than a true reproductive process. Late in the season, when cold weather comes on, males are produced, all being winged; they are known from the winged females by the absence of the tail-like process at the apex of the abdomen. The sexes pair, the females lay eggs, these may remain dormant and be hatched during the following spring, and the young issuing from them are females, capable of giving birth, as before mentioned, to successive broods of young, in a viviparous manner, in the absence of males.

The reproduction of aphides thus presents some of the most remarkable phenomena with which naturalists are acquainted, but which are now explained by corresponding peculiarities in some other groups. A full history of the enquiries of Bonnet and others was given by Mr. Hardy, in a series of papers published some years ago in the *Scottish Gardener*.

Prof. Huxley's important papers "On the Agamic Reproduction and Morphology of Aphis" will be found in the third part of the 22d volume of the Transactions of the Linnean Society (1858).

The following is a detailed description of the wheat or grain aphis:

Aphis Avenæ.—Plump, pale reddish to brown or apple-green (usually pale-red but very various as regards colour), with blackish legs and feelers, appears late in summer in colonies, on flowering panicles of grasses and cereal grains, becoming winged and leaving the ears, as the season advances and the grain ripens.

Viviparous Wingless Female.—Body, medium sized, $\frac{1}{16}$th to $\frac{1}{10}$th of an inch in length, oval-oblong, convex with a rim on each side, more or less glossy, especially when mature, varying in colour from pale apple-yellow to deep reddish yellow or reddish brown when young, becoming darker when old; often of a deep brick-red or chestnut brown, especially on the dorsal surface of the abdomen and other exposed parts, rarely the whole body is of a dull glaucous green, sparsely covered with scattered hairs. The feelers are black, rather more than half the length of the body, rough throughout with bristly hairs, the two basal joints short and thick, especially the first, the terminal one remarkably long and slender, transversely notched throughout its whole length, the intermediate ones four or five times as long as broad (only six joints are developed). The eyes are dark, the rostrum quarter the length of the body, of a yellowish or tawny hue, the terminal joint black, the nectaries almost black. The legs are tawny, the knees, the feet, and the tips of the shanks black, all rather closely covered with bristly hair.

Viviparous Winged Female.—Dark brown, sometimes almost black, feelers longer than the body, hairy, dorsal processes of the abdomen ("nectaries") about a fifth the length of the body; legs dark, the knees, feet, &c., black, hairy; wings ample, colourless, longer than the body. Size of body $\frac{1}{8}$ inch; of the wings $\frac{1}{7}$ inch. Mr. Walker has been very successful in distinguishing aphides by the venation of the wings. I therefore give in his words the description of the wing veins:—" Distance between the first and second veins at the base less than half that between them at the tips; third farther from the second at the tip than it is at the base, as near to the second at the base as the second is to the first; first fork nearer to the second fork than to the third vein, nearer to the third vein than the third vein is to the second; second fork a little nearer to the fourth vein than to the first fork; fourth vein much curved near the base, almost straight towards the tip, very much nearer to the second fork than to the tip of the rib-vein."

The synonymy of this species is as follows :—

Aphis Avenæ, Fabricius. Schrank; Gmelin Ed., Syst. Nat. Linn. 1, pt. 4, p. 2206. Villers, Stewart, Turton Ed., Syst. Nat. Linn. 11, pt. 1, p. 705. Macquart, Walker, "Ann. Nat. Hist. ser. 2, III, pp. 45, 57," and in List of Homop. Insects in Brit. Mus. IV, p. 972.

Aphis granaria, Kirby, "Linn. Trans. IV, p. 238,"

Curtis. Fitch, Count. Gent., Albany, N. Y., Aug. 16, 1861, XVIII, p. 114.

Aphis Hordei, Kyber.

Aphis cerealis, Kaltenbach.

Bromaphis, Amyst, "Ann. Soc. Ent. Fr., 2e Série, V, p. 479.

In order to ascertain with precision whether our Canadian insect was identical with the European one, I sent specimens to Mr. Walker of the British Museum, who is well known to be the ablest authority in this difficult and confused branch of Entomology, and he, in the kindest manner examined the specimens and expressed himself as *sure of its identity with the European species.* Dr. Asa Fitch, of Salem, Mass., who has studied the habits of the new aphis with great care, writes to me that he is satisfied of its identity with the *A. avenæ* of Europe. Mr. Walker in his letter to me dated South Grove, Highgate, near London, Sept. 19, 1861, observes :—"The colour of this and of many other kinds of Aphis is very variable, and is therefore of no use in identifying the species. It occurs of different shades of green-red and of brown, and is occasionally mottled with these colours. I do not think that there is need to be much alarmed at its appearance, or that it will inflict serious or permanent injury, for its swarms are only occasional, and not annual. When it is once established on the corn, the attempt to arrest its ravages is useless, neither do I believe that it can be hindered from migrating to the corn, for its natural or original food is various kinds of grass, and when its wings are developed, and its supply of food fails, it seeks for other means of subsistence. I do not see any mention of it in Fitch's "Noxious Insects," but I believe that his *Aphis Maidis* is the same species. It has been observed on the following plants:—Secale cereale, Friticum æstivum, &c., Avena sativa, Danthonia strigosa, Hordeum vulgare, H. murinum, Bromus mollis, B. secalinus, Dactylis glomerata, Holcus lanatus, Glyceria fluitans, Poa annua, &c., Polygonum Persicaria."

Mr. Walker calls attention to the fact that the aphis has many insect and other enemies in Europe, and it Canada it also has its enemies which have during the past two seasons been busily at work lessening its numbers. These have been so graphicallly depicted by Dr. Fitch, in the Albany Country Gentleman, that I cite his description:—"On many of the wheat heads may at present be noticed from one to half a dozen or more of these lice, which are very large, plump and swollen, of the colour of brown paper, standing in a posture so perfectly natural you suppose they are alive. Touch them with a point of a pin, you find they are dead. Pick off a part of their brittle skin; you see there is inside a white maggot, doubled together like a ball. Put one or two of these wheat heads in a vial, closing its mouth with a wad of cotton. In a week's time or less, you find running actively about in the vial, some little black flies like small ants. These you see have come out from the dead lice through a circular opening which has been cut in their backs. Drive one or two of these flies into another vial, and introduce to them a wheat having some fresh lice. See how the fly runs about among them examining them with its antennæ. Having found one adapted to its wants, watch how dexterously it curves its body forward under its breast, bringing the tip before its face, as if to take aim with its sting. There, the aphis gives a shrug, the fly has pricked it with its sting, an egg has been lodged under its skin, from which will grow a maggot like that first seen inside of the dead swollen aphis. And thus the little fly runs busily around among the lice on the wheat heads, stinging one after another, till it exhausts its stock of eggs, a hundred probably or more, thus insuring the death of that number of lice. And of its progeny, fifty we may suppose to be females, by which five thousand more will be destroyed. We thus see what effectual agents these parasites are in subduing the insects on which they prey. I find three different species of them now at work in our fields destroying this grain aphis. I have not space here to describe them. A particular account of them will be given in my Report in the forthcoming volume of Transactions of our State Agricultural Society. And aiding these parasites in the work which they have been created to perform, are several other insects, to which I can only briefly allude. A lady bug or Coccinella (*C 9-notata*, Herbst) a pretty little beetle, nearly the size and shape of a half pea, of a bright yellow or red color, with nine small black spots, has all season been common in our grain field, it and its larvæ feeding on this aphis. Another insect of the same kind, but much smaller and black, with ten yellow dots on its wing covers, (*Brachyacantha 10-pustulata*, Melsheimer,) is little less common. The Chrosopa, or Goldeneye flies, are also there, placing their white eggs at the summit of slender threads, that their young may feed on these lice. The larvæ of different Syrphus flies, small worms shaped like leeches, may also be seen on the grain heads, reaching about as an elephant does with his trunk, till an aphis is found, which is thereupon immediately seized and pulled from its foothold and devoured."

In Britain, the aphides are fed upon by earwigs.

We have in Canada a large number of aphides, two of which were very destructive last year. One of them, *Aphis Brassicæ*, attacks cauliflowers, Brussels sprouts, cabbages, &c., and another *Aphis Cerasi*, is very injurious to the cherry tree, especially in orchard houses and sheltered situations. These two species have been fully described in the Proceedings of the Botanical Society of Canada.

ARTICLE XXVI.—*On the footprints of Limulus as compared with the Protichnites of the Potsdam sandstone.* By J. W. Dawson, LL.D., F.R.S., &c.

Prof. Owen in his description of the remarkable footprints from the Potsdam sandstone of Beauharnois, submitted to him by Sir W. E. Logan,* after referring these probably to crustaceans, remarks, "The *Limulus*, which has the small anterior pair of limbs near the middle line, and the next four lateral pairs of limbs bifurcate at the free extremity, the last pair of lateral limbs with four lamelliform appendages, and a long and slender hard tail, comes the nearest to my idea of the kind of animal which has left the impressions on the Potsdam sandstone." I do not know that this view of Prof. Owen has ever been subjected to the test of experiment, and having on a late visit to Orchard Beach ob-

* Journal of Geological Society of London. Vol. 8.

tained a living Limulus,* it occurred to me to observe the nature *of its footmarks, and to compare these with the ancient Protichnites.* The Limulus frequents this beach, which in its appearance and character is probably not unlike the sandy flats represented by the Potsdam sandstone, in the spring, for the purpose of spawning, and in storms many of them are cast on shore. In summer they are more rare, and my specimen was a small individual taken in a pool of salt water near the mouth of the Scarborough river. I had no means of preserving permanent impressions of its footprints, but tried its mode of locomotion under various conditions on the sandy shore, and preserved sketches of the markings.

The Limulus is provided with three sorts of locomotive apparatus. In the male three pairs, and in the female four pairs of the thoracic feet are didactyle, walking and prehensile feet, serving for locomotion on hard bottom under water. The posterior pair of thoracic feet are longer and stronger than the others, and furnished, in addition to a small didactyle foot, with four broad, flat claws or nails, which when spread out and pressed against the surface, enable the creature to move on the moist sand of the shore, and also to scoop out the sand and force itself beneath the surface in burrowing. Lastly, the flat abdominal feet are used for swimming, and with the aid of these the creature could rise to the surface and swim around a pail in which it was kept. Its motions were not rapid, and its principal means of security seemed to be burrowing under the sand, and when touched doubling up the abdomen under the thorax in the manner of a Trilobite, though less perfectly, and at the same time erecting and brandishing the sharp caudal spine.

When laid on damp sand near the margin of the sea, the creature immediately began to walk, but in a circuitous manner without apparent object. Its body rested upon the edges of the broad cephalo-thorax, as on a pair of sleigh runners, and it urged itself forward principally by the two posterior feet. The impressions made consisted of two distinct furrows, with slight ridges exterior to these, formed by the edges of the carapace. Within these were series of punctures, deepest behind, in which the four marks left by the nails of the posterior feet were most prominent, and sometimes the only marks seen. In the centre was an irregular groove formed by the tail spine, which was drawn along

* *Limulus polyphemus*, Latreille; *Polyphemus occidentalis*, Lamarck.

the sand, but occasionally moved slightly from side to side, or up and down, in such a manner as to make a broken, irregular trail. When the creature turned abruptly, the impressions on the inner side of the curve were much stronger than those on the outer, and the tail mark became more irregular, or was drawn toward the inner side. Occasionally the spines on the sides of the abdomen touched the ground, and produced slight longitudinal scratches among the footprints. These appearances are represented in Fig. 1, reduced to one-third of the natural size.

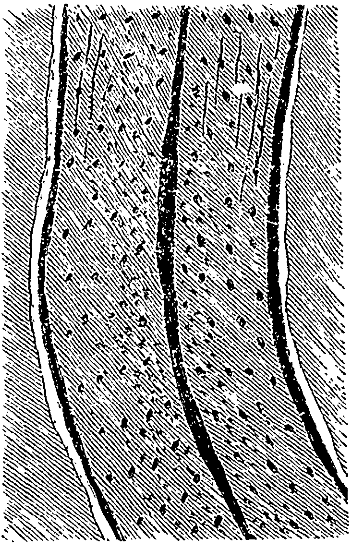

Fig. 1.

As compared with *Protichnites* these tracks of the Limulus agree in the median groove, and in the regularity of the successive groups of impressions at the sides; in reference to which the track of Limulus might be named if it were a fossil, "*Ichnites quatuor-notatus;*" and it is to be observed that in Limulus the regularity of the impressions results from the use of a pair of limbs divided into several strong points at their free extremities. The principal difference is in the lateral grooves, which do not appear in Protichnites, and in the less proportionate size of the impressions of the feet, and the smaller number in each series. It is however to be observed, that my specimen was a small animal, giving an impression only 4 inches wide, and that a full grown female of the American Limulus would give a track fully nine inches in width, and much stronger in the principal impressions, while in such a large track the minor impressions of the anterior feet would also be more distinct.

When the Limulus creeps on quicksand, or on sand just covered with water, so that its body is partly water-borne, it appears principally to use its ordinary walking feet, and the footprints then resolve themselves into a series of longitudinal scratches after the manner of *Protichnites lineatus*, while the lateral and median grooves retain their distinctness, the former being apparently even of greater proportionate depth than on firm sand. This kind of impression is represented in Fig. 2.

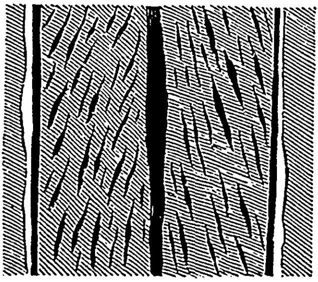

Fig. 2.

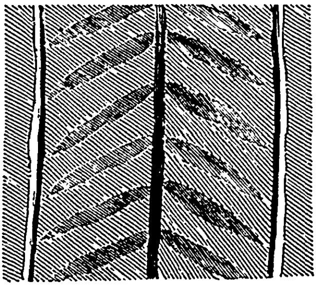

Fig. 3.

When placed in shallow water, just covering the body, the creature used its flat abdominal swimming feet, and though the impression made was very faint, and not readily observed under water, it was obviously very different from those before mentioned, agreeing with them only in the lateral and median grooves, while between these were series of furrows extending obliquely from each side of the middle groove, and resembling ripple marks. (Fig. 3.) These were produced by the sand swept up by the swimming feet. The appearance was not unlike that of the impressions found by Dr. Wilson in beds containing protichnites, and recently described by Sir W. E. Logan in this Journal, under the name *Climactichnites*, except that in the track of Limulus the lateral and medial lines are furrows instead of ridges. The supposition in respect to *Climactichnites* has been, that it is possibly the track of a gasteropod, or of an annelide; but my recent observations of Limulus show that it *may* have been produced by a crustacean moving by broad swimming feet, having a median notch like that in the largest pair in Limulus. To produce all the appearances observed in the climactichnites, it would be necessary that the animal should not trail its tail along the sand, and that the swimming feet should be broad and powerful, and have considerable mobility from side to side. I may also state that at Orchard Beach I was puzzled for some time by small climactichnite-like tracks on the beach, and at length ascertained that they were made by a large beetle * which occasionally settled on the wet sand, and crept for some distance on its surface, apparently making the transverse tracks by means of its tarsi.

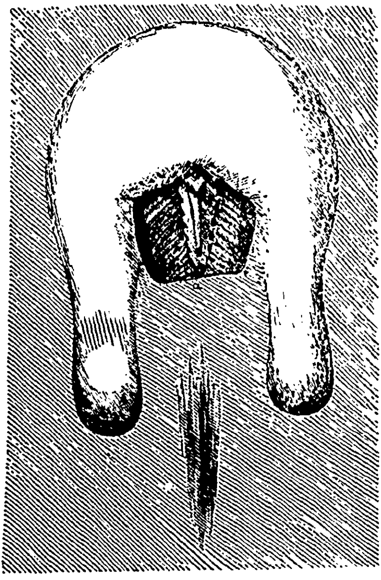

Fig. 4.

The Limulus burrows in wet sand with great ease. It inserts the sharp anterior edge of the cephalo-thorax under the sand like a plough-share, and labouring vigourously with the broad toes of the posterior thoracic feet, throws out sand behind, while it penetrates more deeply in front, at the same time jerking the caudal spine. When nearly buried it presents the singular appearance represented in Fig 4. When it has completely buried itself, it slightly elevates the body and causes the sand to fall off on all sides, so that when it subsides, only a very slight, smooth elevation marks the spot where it is concealed. The form of the ce-

* I suppose *Melolontha (Polyphylla) variolosa.*

phalo-thorax in the Limulus is evidently related to this operation of burrowing, and as in many trilobites it seems even better adapted for such a use, it is probable that they also were burrowers, which would however suppose the existence of strong feet similar to those of Limulus.

From the foregoing observations we may, I think, safely deduce the following inferences respecting Prothichnites:

(1). The conjecture of Owen that they may have been made by a creature somewhat resembling Limulus, is verified by the impressions made by that animal.

(2). The further view of Owen that the grouping of the impressions depended on multifid limbs, and that the number of impressions in a group might indicate specific diversity, is also vindicated by the facts, with this limitation, anticipated by Prof. Owen, that tracks like *P. lineatus*, might have been made by any of the animals which made the other impressions, and that if like Limulus they possessed one large pair of feet making the principal marks, and smaller ones occasionally used, the numbers of marks may have somewhat differed in different circumstances. Still it is evident that a species of Limulus having a different number of divisions of the posterior toes, from that to which these remarks relate, might be distinguished by its footprints.

(3). The animal or animals producing the Protichnites probably resembled Limulus in general form, and in the possession of a strong caudal spine. They probably differed from Limulus in the less breadth or depth of the cephalo-thorax, and in the greater complexity and comparative size of the feet.

(4). Some at least of the Protichnites were probably produced by animals creeping on wet sand; but *P. lineatus* and the *Climactichnites*, if the work of a similar animal, were formed under water. This accords with the view entertained by Sir W. E. Logan as to the conditions of deposition of the Potsdam sandstone; and it is probable that these ancient crustaceans, like the modern Limulus, frequented the sandy beach for the purpose of spawning, and may sometimes have been left dry by the tide.

(5). The suppositions above stated would account for the absence or rarity of remains of the animals which produced the Protichnites. It is rare to find on the modern beach any fragment of an adult Limulus, except on the dry sand above high water mark. The creatures are driven on shore only in storms, and then, owing to the lightness of their crusts, are drifted high on the beach. Their remains are probably to be found in circumstances favourable to their preservation, only on the muddy bottoms at a distance from the sandy shore. Young individuals only appear to frequent the sand in summer, and occasionally to be imbedded in it.

(6). If we enquire what animals, known to palæontologists, have produced the Protichnites, it would seem that no others fulfil the necessary conditions in any particular, except the larger trilobites, for instance those of the genus *Paradoxides*. It is true that we know nothing as yet of the feet of these creatures, but it seems almost certain from analogy that they must have possessed such organs. Nor have these trilobites a caudal spine like that of Limulus; but here again Mr. Billings points out to me that the pygidium of Paradoxides is narrow and spine-like, though I should think not sufficiently so to form the very distinct median groove of Protichnites, unless indeed the creature was in the habit of walking with this organ pointed downward. On the whole we may safely conclude that if any of the larger primordial trilobites were provided with walking and swimming feet of the type of those of Limulus, but differing in details of structure, they may have produced both the Protichnites and the Climactichnites. On the other hand, it is quite possible that these impressions have been formed by crustaceans yet undiscovered, and approaching in some respects more nearly to Limulus than any of the known trilobites. In this last case I should suppose that the animal in question had a flatter or more shallow cephalo-thorax than that of Limulus, proportionately stronger and perhaps more divided feet, and a stouter caudal spine.

It is scarcely necessary to observe that the footprints of Limulus differ materially from those of the higher crustaceans, and also from the galleries formed by many small burrowing crustacea. With these last Mr. T. Rupert Jones, in an interesting article in the "Geologist" for April, seems disposed to compare *Climactichnites Wilsonii;* but this appears to me to have more the character of a surface impression, though what appear to be galleries of small crustaceans are also found in the Potsdam sandstane. The "*Nereites*" of Emmons,* from the Taconic rocks of that author, also resemble in some respects the sub-aquatic trails of Limulus, and may be the work of Trilobites; and the same remark applies to some of the markings from the Clinton of New York, figured by Hall,† and referred to crustacea and worms.

* Agriculture of New York, Vol. I.
† Palæontology of New York, Vol. II, Pl. 13 to 16.

ARTICLE XXVII.—*On the destruction of Apple-trees by* Saperda candida *in Districts surrounding Quebec.* By WILLIAM COUPER, Quebec.

I have been frequently told that apple-trees will not prosper in the districts surrounding Quebec; the reason is stated to be long, severe winters. "In ascending the flank of the hill, (St. Hilaire,) fine orchards of apple-trees were once more observed on the poor granitic gravels, and many of the trees were loaded with fruit. The apple trees do not thrive on the clay soils of the flats of the St. Lawrence, in consequence, I suppose, of their tenacious nature, while good orchards are met with throughout the island of Montreal, where the soil rests upon the limestone, and is more friable."—*N. America, its agriculture and climate, by R. Russell.*

I have quoted the above to show how conflicting opinions are published without proper investigation. I know little regarding the chemical properties of the clay soils or flats of the St. Lawrence, but am informed that apples were at one time produced in large quantities in the Quebec districts.

I have taken the following extract from the Montreal correspondent of the Toronto *Globe*, June 13:—

"I regret to say that there is a poor prospect of fruit this year. Apple, pear, and plum-trees are decaying, as they have been for three years back, caused, it is alleged, by severe frost, and the caterpillars swarm in the orchards."

In my entomological excursions into these districts, I captured the insect which is considered the chief cause, and lost no time in visiting several gardens to examine the trees. The gardeners informed me that the trees were invariably imported from the United States, hence, the insect has been introduced within the young trees from our neighbours' nurseries. I rest satisfied regarding the introduction into Canada of this tree-borer, and will state one reason, that during a residence of seventeen years in Toronto, I never captured the insect; nor will it fill a place in the Upper Canada fauna while they depend on their own nurseries for young trees.

In a garden on the north side of the Beauport road, upwards of twelve trees contained the insect, and had to be taken up, thus affording me an opportunity of cutting them up to obtain their destroyers. In doing so, I discovered what I think is new in entomology, i. e., that in trees containing males no opposite sex were found, and those that contained females had that sex only. The illustration is a fac-simile of a young tree cut off at the trunk, close to the earth. AA are holes from which I procured the perfect beetles.

" The borer of the apple-tree, a white worm or grub, devours

A young Apple-tree showing the holes bored by the larvæ of *Saperda candida*. Fab.

the fragments of wood it gnawed in making its cylindrical path within the trunk of the tree, and pushes the undigested refuse out of the hole by which it has entered. When fully grown it becomes a pupa, which like the door-bug, exhibits short folded legs, wings and horns, of no use to it while within its burrow. Early in June, the pupa-skin is ruptured, and the insect emerges from the tree by gnawing through the thin covering of bark that protects the upper extremity of the hole. Upon issuing into the air it is found to be a beetle,* white beneath, and longitudinally striped with brown above. In this, its perfect state, it lives only upon the young and tender leaves of the apple and other allied trees."—T. W. Harris, *in N. E. Farmer, vol. II.* 1833.

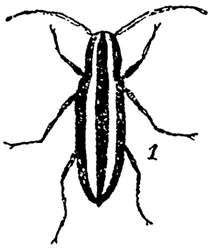

Fig. 1. *Saperda candida.*

Fig. 2. *Larva of Same.*

The above is all that was known of this borer when Mr. Harris wrote in 1833, yet his knowledge of the insect was sufficient to cause the apple growers at that time to look out and prevent its extension. It is from carelessness and inattention that this insect is now found in every apple-growing State in the Union. In 1825 an orchard in the neighbourhood of Troy was injured by this *Saperda* to the extent of two thousand dollars.

The Natural History of New York, vol. V., p. 120, states that the *Saperda candida* is three years in coming to maturity. I have reason to doubt the length of metamorphosis here given by Mr. Emmons, who is not considered an entomological authority—the above book being full of errors. From my own observations, the metamorphoses are gone through annually, that is to say, the *arva* casts its skin periodically for 12 months, the insect appearing in June, and the *ova* deposited in June. The fact of the beetle being "more abundant some years than others," as stated by

* Say, the American entomologist, described this insect as *Saperda bivittata*, two longitudinal stripes running from the thorax to end of elgtra. The Fabrician name is preferable on account of priority.

Emmons, is conclusive evidence that the deposition of the eggs was attended with congenial weather. Any person who has studied the habits of forms constituting the Longicorn family, will hold with me as to the strong parasitical attachment of the parent insects to their favourite plants, while propagating their species; and we have hundreds of instances where insects only take a few weeks to complète their stages, being some years scarce, while at other times so common as to overrun the country.

The *Saperda candida* or apple-tree borer, becomes perfect in the neighbourhood of Quebec, on the 9th of June, and continues to issue from the trees up to the 12th or longer; therefore, the trees should be carefully examined and protected as hereafter specified, during the whole of the above month. The insect invariably deposits its eggs at the base of the tree, where it enters the earth; the larva cuts its way obliquely upwards, cross-cutting the circulation of the sap, and depriving it of its nourishment.

The following instructions should be carried out to ensure success in exterminating the borer:—

1. Import no more young apple-trees from the United States, without a thorough examination for the larva. It would be preferable to obtain them from the Upper Canada nurseries where the insect does not occur.

2. Mix an earth-mortar or clay such as is used for grafting purposes, and with it surround the lower part of the tree, say 1½ or 2 feet. It should have a thickness of 1½ or 2 inches, and made to adhere closely to the earth where the trunk enters it. Apply it also from the 1st of June to any of the attacked trees showing symptoms of life. If there are any perfect insects to issue, escape will be cut off, and much good done in this way. It is useless to use solutions of any kind, as the larva ascend the tree and will remain untouched.

3. It would be advisable to use the same precaution with pear trees during this period, as the apple-borer may select them when deprived of its more congenial tree.

ARTICLE XXVIII.—*Discovery of Microscopic Organisms in the Siliceous Nodules of the Palæozoic Rocks of New York.*

At Prof. Dana's suggestion, Dr. M. C. White, well known for his devotion to the microscope, has examined various specimens of the hornstone nodules found in the Devonian and Silurian rocks of this country, with a view to determine the presence of organisms analogous to those well known to exist in the flints of the Chalk. This research has been rewarded by the discovery of abundant organisms referable to the Desmidieæ, besides a few Diatomaceæ, numerous spicula of sponges, and also fragments of the teeth of Gasteropods. Among the Desmids, there is a large variety of forms of Xanthidia supposed to be the Sporangia of Desmids, besides an occasional duplicated Desmid; also lines of cells, some of which appear to be sparingly branched. The researches have been mostly confined to the hornstone of the Corniferous limestone; though extended also to the hornstone from the Black River limestone and that of the sub-Carboniferous limestone of Illinois, both of which contain some organisms.

The hornstone nodules from the Black River limestone (as well as the Corniferous) have been since examined also by Mr. F. H. Bradley with similar results.

These observations will be regarded with much interest by geologists as well by miscrocopists: They carry back to a very early epoch forms of life which have hitherto been looked upon as belonging only to a much more recent era in the life of our planet.

The analogy of these hornstone nodules to the flints of the Chalk is obvious; and the discoveries here anounced may be regarded as establishing their similarity in origin. The organisms figured so closely resemble those of the flint that they might be taken for them; it is difficult in all cases to make out a difference of species.

The extreme abundance of the hornstone nodules in our palæozoic limestones will render it easy to multiply observations in this new field of research, which presents an interesting addition to the labors of the microscopist. It will be remembered by those who undertake such examinations that the use of turpentine renders the chips of chert almost as transparent as glass.—

To the Editors,—Having recently been engaged in examining the microscopic structure of hornstone from Palæozoic rocks, I send you the accompanying sketches of organic forms which I have discovered. They consist of spicules and gemmules of sponge and fragments of sponges; Desmidieæ, several species of Xanthidia, and disks which *probably* are to be considered as Diatoms. Hornstone from the corniferous limestone of central and western New York contains the greatest variety of these organic forms. A few specimens have been found in hornstone of the Black River Limestones from Watertown, N. Y. * * * *

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These investigations were undertaken at the suggestion of Prof. Dana, who furnished the specimens of hornstone, the examination of which has enabled me to make these most interesting discoveries. Yours, &c. M. C. White.

New Haven, Conn., March 22, 1862.—*Am Jour. of Science.*

[We commend the above interesting discovery to the notice of microscopists in Canada. Some of our oldest limestones and cherts, as for example those of the limestones of the Quebec group, present a microscopic appearance similar to that of ordinary flint, and contain numerous minute fragments and globular and spicular bodies, some of which may probably be of the same nature with those discovered by Dr. White, though we have not as yet been able to satisfy ourselves of their organic character. Eds.]

ARTICLE XXIX.——*List of Orthoptera collected on a trip from Assiniboiâ to Cumberland.* By Samuel H. Scudder.

The species enumerated below were obtained during a canoe trip, taken during the summer of 1860, from the Red River settlements to the Pas on the Saskatchewan River, and during a few days stay at Fort Garry at the former place. The collections made were small in number both of individuals and of species, because of the meagre opportunities given for collecting upon a hurried trip of this nature, but are interesting because of having passed—so far as the trip extended—over the exact route, taken by Sir John Richardson when making the collections which formed the basis of Kirby's work on the Insects of Boreal America. I have been enabled to determine, with but the least degree of doubt, the few *Orthoptera* described by him, which since his day have been involved in obscurity. This list lays no claims to completeness, but as being an advance on anything hitherto known, it is offered with the hope that by exhibiting to others the meagreness of our knowledge of the Orthopteran fauna of the great North-West, it may stimulate increased activity in this interesting department, where so much remains to be done. Collections from every portion of the British Provinces are earnestly solicited by the author, the most common no less than the uncommon species, in return for which he will be glad to furnish labelled series of collections sent, or of species found within the limits of New England.

Cambridge, Mass. July 8th, 1862.

PHASMIDÆ—Leach.

DIAPHEROMERA, Gray.

D. FEMORATA.

Spectrum femoratum, Say, App. Long's Second Exp. 297.

Diapheromera Sayi, Gray, Synopsis of Phasmidæ, 18.

Bacteria (*Bacunculus*) *Sayi*, Burm. Handb. d. Ent. II, 566.

A single specimen was brought to me at the Selkirk settlements on Red River. I have seen specimens also from Massachusetts, N. Hampshire, Illinois, and Nebraska.

LOCUSTARIÆ—Latreille.

UDEOPSYLLA, Scudd.

This genus is to be placed between *Ceuthophilus*,* Scudd. and *Daihinia*, Hald. The maxillary palpi are rather long: the first and second joints equal and small; third more than equal to the preceding together; fourth little more than half as long as third; fifth a little longer than third, somewhat curved, split along the whole under side. As in *Ceuthophilus* the pro- meso- and meta-nota nearly conceal the epimera of the thoracic segments. Hind femora very heavy, thick and especially broad, but not so much so as in *Daihinia*, where, as in this genus, the whole limb is swollen, and not the basal portion only, as in the neighboring genera; it differs from *Daihinia* in the structure of the tarsal joints, which here have the first and fourth joints equal and longest, the second and third equal and small, the second overlapping the third above.

Daihinia robusta, Hald. is the type of the genus, a species found in Nebraska.

U. NIGRA, nov. sp.

Shining black, with a faintly indicated, narrow, reddish, dorsal line, a reddish tinge on the front of the face, the basal half of the inner surface of hind femora, and the terminal half of the ovipositor reddish; the hind femora of the male have upon either edge of the under surface, but especially on the inner, short but heavy spines, not crowded, the hind tibiæ are furnished on either edge of the upper surface with four or five opposite, long and slender spines, between each two of which are placed three or four suppressed spines; there is a single row of short spines upon the

* *Ceuthophilus* is a new genus, of which *Rhaphidophora maculata*, Harr, is the type, for full characteristics of this and *Udeopsylla* see an article on N. American Orthoptera, presented to the Boston Society of Natural History in May, 1862, and now publishing in their Journal, Vol. VII, No. 3.

under surface, which become double towards the tip; the inner valves of the ovipositor have five teeth growing longer and more curved towards the tip, where they are very long and slender.

Length of body, .8–9 in.; of hind femora, .68 in.; .56 in.; of ovipositor, .33 in.; of antennæ, about 1 in.

This species was taken by Mr. Kennicott at Red River, and I obtained it in northern Minnesota, upon the Red River trail, leaping about in the grass, at mid-day.

PHANEROPTERA, Serville.

P. CURVICAUDA, Serville, Ann. Sc. Nat., 1st ser. XXII, 159.

Locusta curvicauda, De Geer, Mem. III, 446, Pl. 38, fig. 3.

Gryllus (Phyllopterus) myrtifolius, Drury, Ill., Ex. Ent. (Westwood's edition) II, 88, Pl. 41, f 2 (Syn. del.).

Phaneroptera angustifolia, Harris, Report Ins. Mass., 3d edition., 160, fig. 76.

This species varies very much in size and in the proportions of the wing-covers. I obtained it at Red River, and have seen it also from most of the N. England states, where it is somewhat abundant.

[I enclose the two succeeding species in brackets, because I have very strong doubts whether the specimens obtained by me are referable to the species mentioned, and I only place them there now in order to indicate their affinities.

XIPHIDIUM, Serville.

X. FASCIATUM, Serv., Ann. Sc. Nat., 1st ser. XXII, 159.

Locusta fasciata, De Geer, Mem. III, 458, Pl. 40, fig. 4.

Orchelimum gracile, Harris, Rep. Ins. Mass. 3d ed. 163, fig. 78.

I have this species in large numbers from New England; those obtained at Red River differ from these in having a larger body, and a longer ovipositor.

X. BREVIPENNIS, nov. sp.

This species as found in New England may be characterized thus: Size of *X. fasciatum*, with which it agrees in coloration throughout, except that the wings are a little darker, the dorsal band is a little broader and is of a reddish brown throughout, while in *X. fasciatum* it is green at the base: wings .08 in. shorter than the wing covers, both shorter than the body; ovipositor nearly equalling the hind femora in length: in these respects it differs very much from *X. fasciatum*.

Length of body, .5 in.; of wing covers .33 in.; of hind femora .43 in.; of ovipositor .4 in.

The single specimen I have from Red River is smaller than any I have seen elsewhere, has no wings, and the wing covers but .14 in. in length.]

ACRYDII—Latreille.

CHLOEALTIS, Harris.

C. CONSPERSA, Harris, Report Ins. Mass., 3d Ed. 184.

C. abortiva, " " " "

This species was obtained in abundance on the 4th July, at Dog's Head, eastern shore of Lake Winnipeg, leaping about actively when disturbed, and apparently living exclusively among the lichens which bordered the patches of rocks.

STENOBOTHRUS, Fischer Fr.

S. CURTIPENNIS.

Chloëaltis curtipennis, Harr., Report Ins. Mass. 3rd ed. 184 pl. 3, fig. 1.

This species, which is one of the commonest N. England forms, was found abundantly at the Red River settlements. The figure in Harris' Report is quite inaccurate.

ARCYPTERA, Serville.

A. GRACILIS, nov. sp.

Vertex of the head rather broad, swollen at front border of the eye, the edge raised to a ridge, with a medial ridge extending over the whole top of the head; foveolæ long and narrow, triangular, rather deep; pronotum rugose; wing covers short and broad, costal border somewhat swollen near the base, internal border full.

Dark brown; a narrow curved dark line extends from the upper border of the eye to the lateral carinæ of the pronotum, and is the inner limit of a rather broad brownish-yellow band, which extends from the hind border of the eye to the lateral carinæ, whence it continues backwards crossing the carinæ; below this upon the upper border of the sides extends a narrow black band from the eye to the hind edge of pronotum; the medial carina is black; wing-covers uniform dusky brown, except the internal border, which is yellowish brown; wings dusky, with a yellowish tinge on the internal half; hind femora reddish, black at apex; hind tibiæ yellow with black spines, with the base and apex black, and a dark annulation at the upper limit of the spines.

Length of body ·85 in.; of wing-covers ·78 in.; breadth of wing-covers in middle ·22 in.; length of hind femora ·52 in.

This species seemed to be rather abundant at Red River. I know it elsewhere only by a single specimen from Maine.

PEZOTETTIX, Burmeister.

P. BOREALIS, nov. sp.

Vertex of the head with a broad longitudinal furrow in advance of the middle of the eyes; sides of pronotum very nearly parallel, slightly wider at hind border, which is arcuate; medial carina slightly higher than the lateral, not prominent; wing-covers longer than the wings, not quite reaching the extremity of the abdomen.

Dark brown, darkest above; a broad black band behind the eye, extending over the upper portion of the sides of the pronotum to the hind border; front dark yellowish brown, mouth parts dirty yellowish; legs yellowish brown; hind femora streaked with black, with the apex black; hind tibiæ reddish, with a faint paler annulation near the base, the spine tipped with black; wing-covers dirty yellowish brown, spotted irregularly with darker brown; wings colorless, a little dusky on costal border.

Length of body ·65 in.; of wing-covers ·4 in.; of hind femora ·4 in.

This species is fond of places where the grass grows thinly. I obtained specimens at the Pas on the Saskatchewan River, and at different points along Lake Winnipeg. I have also seen mutilated specimens, doubtless of this species, from the Island of Anticosti in the Gulf of St. Lawrence.

CALOPTENUS, Serville, (emend).

C. FEMUR-RUBRUM, Burn. Handb. d. Ent. II. 638.

Acrydium femur-rubrum, DeGeer, Mem. III. 498 Pl. 42, fig. 5.

Acrydium femorale, Oliv. Encyc. Meth. IV. 228.

This is a wide spread and exceedingly abundant species. I found it in considerable quantities at Red River, and I have specimens also from Minnesota, Illinois, Nebraska and N. England.

C. BIVITTATUS, Uhler in Say's Ent. of N. Am., ed. Leconte, II. 238.

Gryllus bivittatus, Say, Journ. Ac. Nat. Sc. Phil. IV. 308.

Locusta leucostoma, Kirby, Faun. Bor. Am. IV. 250.

Caloptenus femoratus, Burm. Handb. d. Ent. II. 638.

Acrydium flavovittatum, Harris, Report Ins. Mass., 3rd ed. 173.

I found this species in considerable abundance in grassy places along the shores of Lake Winnipeg, particularly near the mouth of the Saskatchewan. It is a wide spread species; for I have seen specimens from as widely separated localities as Maine, Maryland, Texas, Nebraska, Illinois, Minnesota, and Lake Winnipeg.

ŒDIPODA, Latreille.

Œ. ÆQUALIS, Uhl. in Harr. Report Ins. Mass., 3rd ed. 178.

Gryllus æqualis, Say, Journ. Acad. Nat. Sc. Phil. IV. 307.

This species was not found farther north than the southern shore of Lake Winnipeg. I have taken it also in Minnesota and N. England.

Œ. VERRUCULATA.

Locusta verruculata, Kirby, Faunn. Bor. Am. IV. 250.

Locusta latipennis, Harr. Report, Ins. Mass., 3rd ed. 178.

I found this species at Pt. Wigwam, Lake Winnipeg, on 1st August, abundant at mid-day flying about on the sandy spots, like the preceding species it makes a crackling noise with every successive flutter of its wings. I have seen it elsewhere only from N. England.

Uhler, (Harr. Report Ins. Mass., 3rd ed., 178,) considers this to be identical with the previous species, in which opinion I can hardly concur—it differs from *Œ. æqualis* in the following particulars: in *Œ. æqualis* the black band across the middle of the wings is broad, its outer edge as well as the inner distinct, the outer border at first straight, then well rounded, curving inwards where it approaches the outer border; beyond the band the wing is pellucid with black veins not cloudy, and at the tip there is either a dusky patch, or irregularly clustered square blackish spots; in *Œ. verruculata* the inner border of the band is more wavy and is illy defined; the outer border is straight, and where it approaches the outer border of the wing is turned slightly outwards instead of inwards, and is frequently very indistinct, being merged into the more or less dusky space beyond it, which increases in cloudiness to the tip, where it is as dark as the band; the band itself is quite narrow in the middle, so that it might be said to be made up of two triangular patches which meet and merge in the middle; the broadest band I have seen in *Œ. verruculata* is not more than half the width of the narrowest I have observed in *Œ. æqualis*; in *Œ. æqualis* the hind tibiæ are either wholly coral-red, or have a pale yellowish annulation at the base; in *Œ. verruculata* the tibiæ have the base and apex black, with the middle half yellowish, with generally a dusky annulation in the middle.

TETRIX, Latreille, (emend).

T. GRANULATA.

Acrydium granulatum, Kirby, Faun. Bor. Am. IV. 251.

Tetrix ornata, Harris, Report Ins. Mass., 3rd ed. 186.

(Not *Acrydium ornatum*, Say, Am. Ent. I. Pl. V.)

I have not seen this species from British America, but only from northern Minnesota, on the Red River trail, and from N. England, but mention it here because of its having been first described by Kirby. It is not the species described by Say under the name of *ornatum*, although it is closely allied to it—it differs from *ornatum* in the longer extension of the pronotum backward, its greater size, and in the prominence of the vertex, which is angulated in front—it varies much in coloration.

ARTICLE XXX.—*On the Mammals and Birds of the District, of Montreal.* By ARCHIBALD HALL, M.D., L.R.C.S.E.

(Continued from page 193.)

Turdus noveboracensis. Aquatic Thrush.
T. aquaticus of Audubon !
Sylvia noveboracensis. Latham and Buonaparte !!

V.S.P. Legs and bill brown; irides black; bill slightly notched; eggs 4 to 5, flesh colour, spotted dark towards the larger end.

Dorsal aspect. Olive brown, with a ring of a lighter tint round the neck.

Ventral aspect. A line from the nostrils over the eye, terminating beyond the auriculars of a cream colour; auriculars pale brown; sides of the neck, throat, breast, belly, vent, and tail coverts yellowish white, thickly spotted with brown streaks, most numerous and largest on the breast, and finest on the throat.

2nd and 3rd primaries subequal and longest; 1st longer than the 4th. Length 5¼ inches; alar breadth 8 inches. The female differs little.

T. aurocapillus. Golden-crowned Thrush.
Sylvia aurocapilla of Buonaparte !
Seirus aurocapillus. Baird !

V.S.P. Bill short, and with the legs pale flesh colour; irides hazel; eggs 4 to 5, white mottled with reddish brown.

Dorsal aspect. Olivaceous yellow; crown brownish orange, with a lateral border of black from the nostrils, lost upon the occiput, succeeded by the dorsal tint immediately above the eye; primaries and secondaries ashy, edged with whitish.

Ventral aspect. Pure white with black spots on the sides of the neck, breast and flanks; inner wing coverts pale yellow; eyelids white.

1st, 2nd, and 3rd primaries equal. Length 6 inches; alar breadth 9 inches.

Genus Tanagra.

Gen. char. Bill short, robust, triangular at the base, carinate; upper mandible curved and notched wider than, and projecting over, the lower one; lower one straight, somewhat gibbous towards the middle; nostrils basal, round, and open; tarsus equal to the middle toe; external and middle toe connected at base; 2nd and 3rd primaries longest.

T. rubra. Scarlet Tanager.

Pyranga rubra. Linn.! Viell.! Baird!

V.S.P. Bill horn coloured, black at the base; legs and feet bluish; irides deep hazel; according to Nuttal "cream colour," which I never observed, although I have inspected upwards of a hundred specimens. Eggs 3 to 4, dull blue, mottled with brownish purple towards the larger end.

Dorsal aspect. Scarlet, varying in depth of tint from the brightest to an orange; wings and tail black, the latter emarginate.

Ventral aspect. Scarlet, paler about the vent.

2nd primary longest; 1st a little shorter than the 3rd. Length 6¾ inches; alar breadth 11 inches. The young bird has some touches of green about it, especially among the scapulars, and the ventral aspect inclines to a yellowish tinge.

T. æstiva. Summer Redbird.

Pyranga æstiva. Gmel.! Linn.! Viell.! Baird!

V.S.P. Bill horn coloured, whitish where the mandibles meet; legs and feet greyish blue; irides hazel; eggs 4 to 5 light blue.

Dorsal aspect. Crimson; wings light brown, the edges of the outer vanes margined with greenish yellow; tail composed of 12 feathers; the two external ones greenish yellow, the middle ones crimson.

Ventral aspect. Crimson.

Length from extremity of tail to beak 7½ inches; alar expanse about 9½ inches.

This is a beautiful bird but very rare. In all my rambles I never met with it. The specimen before me, and which I have described, is a young bird, shot by Mr. Hunter, taxidermist to the Natural History Society, on the mountain. He was accompanied by an associate which Mr. Hunter could not succeed in obtaining. The old bird differs from the young one in having, according to Audubon, "the tips and inner webs of the quills tinged with brown."

The adult female differs essentially from the male. Thus according to the same authority, "the general colour above is light brownish green, the sides of the head, and the under parts generally are brownish yellow; large wing coverts dusky edged with yellow; quills deep brown, externally margined with yellowish red; tail feathers of the same colour." This with its congener are our two most flashy birds.

Genus Quiscalus.

Gen. char. Bill moderately long, compressed, entire, with sharp and inflected edges; upper mandible projecting over the lower, and extended backwards on the forehead; nostrils oval, half closed by a membrane; outer and middle toe connected at the base; 2nd and 3rd primaries longest; tail more or less rounded.

Q. versicolor. Purple Grackle.
Gracula quiscala.
Quiscalus versicolor. Baird!

V.S.P. Bill, legs and feet black; irides white; eggs 5 to 6 dull green, blotched and spotted with dark olive.

Dorsal and ventral aspects. Black, with a purple or steel blue iridescence on the head and neck; bronze on the belly and back, and bronze and violet on the greater wing coverts and secondaries; primaries black without iridescence; tail rounded almost cuneiform, with steel blue reflections.

3rd primary longest; 1st, 2nd, and 4th subequal. Length 12 inches; alar breadth 17½ inches. Female less brilliant than the male.

Q. baritus. Common Blackbird.
Gracula barita of Linnæus!
Oriolus niger of Gmelin.
Qniscalus baritus. Baird!

V.S.P. Bill, legs and feet black; irides black; eggs 5, dark coloured spotted with dusky.

Dorsal and ventral aspects. Deep black, with a faint steel blue iridescence, inclining to green about the wings; feathers generally faintly tipped with brownish; tail nearly square; lateral feathers on each side shortest; ½ inch shorter than the centre ones.

2nd primary longest; 1st next. Length 9 inches; alar expanse 14½ inches. According to Nuttal the female is dull brownish, with the eyebrows and ventral aspect whitish.

Q. ferrugineus. Rusty Grackle.
Gracula ferruginea of Wilson.
Scolecophagus ferrugineus? Baird!

V.S.P. Legs, bill and feet black; irides white; eggs 5, dusky spotted with black.

Dorsal and ventral aspects. Glossy black, with ferruginous tips to the feathers; head and neck iridescent with dark green.

2nd primary longest; tail rounded. Length $9\frac{1}{2}$ inches; alar expanse 15 inches. The female has the belly and rump ashy.

Genus Oriolus.

Gen. char. Bill conic, horizontally compressed at the base; upper mandible ridged and carinate; nostrils basal, lateral and naked, and horizontally pierced in a large membrane; tarsus and middle toe subequal in length; outer and middle toes connected at base; 2nd primary longest.

O. Baltimorus. Baltimore Oriole.

Icterus Baltimorus. Buonaparte! Baird!

V.S.P. Bill, legs and feet pale blue; irides deep hazel; eggs 4 to 5, bluish white, spotted and streaked with dark brown; nest pendant.

Dorsal aspect. Head, neck, and back deep black; rump orange; tail square, the two central feathers black with minute orange tips; all the lateral ones black with their distal halves orange; smaller wing coverts orange; greater ones black tipped with white on their outer vanes, the three or four last secondaries similar; primaries and the other secondaries black, with faint emarginations of white on their outer vanes.

Ventral aspect. Neck black, terminating in a cone on the lower part of the throat; breast and all the other parts orange.

2nd primary longest; 1st and 3rd very little shorter. Length $7\frac{1}{2}$ inches; alar breadth 11 inches. The female differs considerably from the male. Her dorsal aspect is yellowish brown, with the tail olivaceous; the wing coverts tipped with yellowish; secondaries much more broadly margined with white than in the male; head of the dorsal tint. Ventral aspect yellowish.. Taken from a living female in the author's possession; her second moult. The winter plumage is the same as the summer.

Family II. Fissirostres.

Genus Hirundo.

Gen. char. Bill short, triangular, depressed and wide at the base, and cleft nearly to the eyes; upper mandible notched, and a little hooked at the point; nostrils basal, oblong, semi-closed by a membrane; exterior and middle toes united to the first joint; 1st primary longest; tail more or less furcate.

H. purpurea. The Purple Martin.

Progne purpurea. Linn.! Baird!

V.S.P. Bill, legs and feet black; irides hazel; eggs 4 to 6, white.

Dorsal and ventral aspects. Prussian blue, with purplish steel reflections; tail furcate, and as well as the wings sooty brown.

1st primary longest. Length 9 inches; alar breadth 16½ inches. The female is greyish on the ventral aspect, and with the young bird of the first moult is altogether not nearly as brilliant in appearance.

H. rufa. The Barn Swallow.
H. Americana. Wilson!
H. horreorum. Barton! Baird!

V.S.P. Bill black; legs and feet purplish black; irides hazel; eggs 4, white spotted brown.

Dorsal aspect like the last; frontlet ferruginous.

Ventral aspect. Throat ferruginous; breast covered by a purple band; belly, vent, wing and tail coverts of a pale ferruginous tint.

Tail deeply furcate; lateral feathers twice as long as the centre ones, and all spotted with white on their inner webs, presenting a crescentic band which is most conspicuous on the lower surface; wings and tail feathers brownish black; 1st primary longest. Length 6½ inches; alar breadth 12½ inches. The female has the belly and vent rufous white.

H. bicolor. White-bellied Swallow.
H. viridis. Wilson!

V.S.P. Bill, legs and feet blackish; irides hazel; eggs 4 to 5, white.

Dorsal aspect. Blue, with purple reflections.

Ventral aspect. White, inclining to greyish on the flanks; tail subfurcate; wings sooty brown.

1st primary longest. Length 5½ inches; alar expanse 11 inches. The female and young resemble the male.

H. fulva. Cliff Swallow.
H. lunifrons. Say! Baird!

D.C. "Blue black; beneath brownish white; throat and rump ferruginous; front with a paler semilunar band; tail even; tail coverts pale yellowish red; wings and tail brownish black. Length 5½ inches; alar extent 12 inches."—(Nuttall).

Genus Caprimulgus.

Gen. char. Bill slender, short, depressed, and cleft beyond the eyes; upper mandible generally furnished with long bristles; slightly hooked; nostrils basal, wide, more than half closed by a feathered membrane, having a tubular opening; anterior toes united as far as the first joint; middle claws long and pectinate; hind toe versatile; 2nd and 3rd primaries longest.

C. vociferus. The Whip-poor-will.
Antrostomus vociferus. Wils.! Buonap.! Baird!

V.S P. Bill black; legs and feet whitish; irides deep hazel; eggs 2, bluish white blotched with dark olive.

Dorsal aspect. Feathers of the head and back minutely speckled with brown and white, with black streaks along the shafts; a ferruginous tint prevails on the scapulars and coverts, the former of which are broadly tipped with black; tail round; the three lateral tail feathers white on their distal halves; the others speckled and barred with black, brown, and ferruginous; primaries and secondaries brown, speckled with ferruginous towards their extremities; with ferruginous spots, causing bars on the outer and inner vanes of both.

Ventral aspect like the dorsal; a narrow white line traverses the throat, and a pale ferruginous tint prevails on the abdomen, though much intermingled with black; vent feathers and inner tail coverts pale ferruginous.

2nd primary longest; 3rd next; 1st a little longer than 4th. Length 10½ inches, alar breadth 19 inches; middle claw pectinate on its inner margin. The female has the white parts of the male pale ochreous.

C. Virginianus. Night Hawk or Mosquitoe Hawk.
Chordeiles popetue? Baird!

V.S.P. Bill black; feet and legs blackish; irides deep hazel; eggs 2, bluish white mottled with umber colour.

Dorsal aspect. Glossy brownish black, speckled with numerous small spots, and narrow zigzag bars of a pale grey or cream colour; the cream colour predominating on the scapulars; wings brownish black, tipped with soiled white, and intersected on the five first primaries by a white spot forming a band; the white spot obsolete on the outer vanes of the 1st; tail furcate, blackish brown barred with grey. "In the male there is a white band on the tail."—(Nuttall).

Ventral aspect. A white spot on the throat; breast, belly and vent dirty cream colour, barred with blackish brown; the bars largest and most distinct on the belly; most numerous and least distinct on the breast and chin.

1st primary longest. Length $9\frac{3}{4}$ inches; alar breadth 22 inches.

C. Americanus, Linn.!

V.S.P. Bill and legs pale flesh colour; the former black towards the tip; irides hazel.

Dorsal aspect. Prevailing tint a light coloured brown or fawn colour, intersected on the crown of the head by a narrow black streak; feathers of the occiput minutely powdered with light fawn; those of the neck with a black bar tipped with cream colour; scapulars brown, distal halves of their outer vanes black, with cream coloured edges and barred below the surface; small wing coverts brown, minutely barred and powdered with black; greater wing coverts brown, barred and speckled with black; a well defined bar towards their extremities, succeeded by a cream coloured tip; tail rounded, lateral feather and quill half of the outer vane of 2nd feather brownish black; the remainder of the outer vanes and whole inner vanes of 2nd, and whole of the 3rd white; centre feathers of the prevailing dorsal tint with 10 to 11 bars of black, and speckled with the same colour in the intermediate spaces; wings brown; the 5 first primaries with a white bar across the outer and inner vanes, not obsolete on the outer vanes of the 1st.

Ventral aspect. A white spot on the throat; breast and chin ferrugineous, barred with black; belly and vent pale ferruginous, barred with dusky.

Bill with bristles projecting about 4 lines beyond the extremity of the bill; legs longer than the C. Virginianus; 1 inch, 3 lines from the knee to the tarsus; middle toe with claw as long as the tarsi, inner edge of the claw pectinate. Length $10\frac{1}{2}$ inches; alar breadth 18 inches. 3rd primary longest; 2nd and 4th equal; 1st a little longer than the 5th.

Described from a specimen in the museum of the Natural History Society of Montreal.

This is a Mexican species, which in its wandering contrived to reach this neighbourhood. It was shot on the mountain by the late Mr. Broome, who held for many years the situation of taxidermist to the Natural History Society. It was identified by Mr. Cassin of Philadelphia, as a Mexican species, under the above designation. *See appendix.*

Family III. Conirostres.

Genus Alauda.

Gen. char. Bill short, conic; mandibles of equal length; upper one convex and entire; nostrils basal, oval, partly concealed by the feathers of the forehead; tongue bifid; toes free; hind claw prolonged, nearly straight, and longer than the toe; spurious feathers short or aberrant; 2nd and 3rd primaries longest; two of the scapulars nearly as long as the primaries; tail furcate; coronal feathers erectile at pleasure.

A. alpestris. Shore Lark.

V.S.P. Bill dusky; legs and claws black; irides hazel; eggs unknown.

Dorsal aspect. Frontlet, and line over and round the eye, ending above the eyes yellow, succeeded on the forehead and sides of the head by black; nape of neck, crown of head, and dorsal region reddish fawn; small wing coverts tipped with white; dorsal feathers with central black streaks; tail square; lateral feathers white on their outer vanes; all the rest blackish brown except the two centre ones which are broadly edged and tipped with fawn verging to white; wings brownish black; secondaries and two or three last primaries edged with whitish, and tipped with the same; outer vane of 1st primary altogether white.

Ventral aspect. Auriculars light brown, a black streak from the angle of the mouth to the cheeks, gradually increasing in breadth; upper part of the throat and sides of the neck yellow; breast with a broad black crescent; abdomen, wing and tail coverts white; vent and sides of the breast fawn.

2nd primary longest; 1st shorter than 3rd, but two lines longer than the 4th. Length $7\frac{1}{2}$ inches; alar breadth 13 inches.

Genus Parus.

Gen. char. Bill short, straight, conic, compressed entire, furnished with nuchal bristles; nostrils basal, rounded, and concealed by the projecting feathers of the forehead; feet with the toes divided; hind claw strongest and most bent; 4th and 5th primaries the longest.

P. Palustris. Black-capped Titmouse.
P. atricapillus. Baird!

V.S.P. Bill black; legs bluish; irides dark hazel; eggs 6 to 12, white speckled with reddish brown.

Dorsal aspect. Crown, occiput, and nape of neck black; auriculars and cheeks white, projecting conically forward to the angle of the bill; dorsal region bluish grey; wings and tail darker, the former edged with whitish.

Ventral aspect. Chin and throat black; the sides white tinted with brown.

Length 5½ inches; alar expanse 6½ inches; head not crested. (Compiled from Nuttal).

Genus Emberiza.

Gen. char. Bill short, compressed, conic, with inflected edges; upper mandible narrower than the under; nostrils basal, rounded, partly concealed by projecting feathers from the forehead; toes divided; hind claw short and bent; tail more or less furcate.

E. nivalis. The Snow Bunting.
Plectrophanes nivalis. Linn.! Baird!

V.S.P. Bill yellowish; legs and feet black; irides deep hazel; eggs 5, whitish mottled with brown and grey.

Dorsal aspect. (Winter plumage as they appear in this district). Crown, occiput, and nape of neck stained with rufous; dorsum interscapular region and scapulars black, the feathers tipped with rufous; greater and smaller wing coverts and rump white; tail coverts black with white tips; spurious wing feathers black; primaries blackish brown, white at their insertion and with white margins on their outer vanes and tips; secondaries, except the four last which have rufous outer margins, white; tail subfurcate, their lateral feathers white with black tips, the rest blackish brown with white margins and tips.

Ventral aspect. White, with rufous stains on the throat, sides of breast and flanks.

1st primary longest. Length 7¼ inches; alar breadth 13 inches. This bird varies considerably in the minor shades which characterize its plumage.

E. lapponica. Lapland Longspur Bunting.
Plectrophanes lapponica. Linn.! Baird!

V.S.P. Bill yellow tipped with black; legs and feet black; irides hazel; eggs 5 to 6, yellowish rusty clouded with brown.

Dorsal aspect. Front, and crown of the head black; nape of the neck rufous; back, rump, tail coverts and scapulars blackish brown, with broad rufous edging and tips; greater and smaller wing coverts blackish brown tipped with white; tail and quill feathers black, edged with white on the outer vanes; the lateral tail feathers on the whole of the outer vane, and distal half of the inner vanes, with a tear shaped spot of blackish brown on the extremity of the shafts.

Ventral aspect. Breast, throat, chin, and cheeks black; a white line from the nostrils proceeds along the eye, and soon acquires a yellow tint, and gradually increasing in breadth descends behind the auriculars, and separates the black cheeks from the rufous sides of the neck; belly, vent and tail coverts white; flanks streaked black.

1st and 2nd primaries equal. Length 6½ inches; alar breadth 11 inches; hind claw with nail 11 lines long.

Genus Fringilla.

Gen. char. Bill short, robust, conic, unnotched; upper mandible wider than the lower, gibbous, with the apex slightly inclined; nostrils basal, round, concealed by the feathers of the forehead; tarsus shorter than the middle toe; all the toes free; hind nail longest and largest; wings rounded; 3rd and 4th primaries longest; tail square or subfurcate.

F. cyanea. Indigo Finch.

Cyanospiza cyanea. Linn.! Baird!

V.S.P. ET V. Lower mandible pale; upper one, legs and feet black; irides black or very deep hazel; eggs 5 greenish white without spots.

Dorsal aspect. Sky blue, deepening on the head and neck into a fine ultramarine; back and rump blue, with a verdigris green reflection; greater and smaller coverts black broadly tipped with blue; quills of the wing and tail blackish brown, the former edged with verdigris green, the latter with pale bluish white.

Ventral aspect. Ultramarine on the throat and upper part of the breast, changing to a verdigris green on the abdomen; vent pale brown; tail coverts blue tipped with white.

2nd primary longest. Length 5½ inches; alar breadth 8 inches. The female is flaxen tinged with ferruginous; cheeks and below ferrugineous white; lower mandible almost white. In the winter plumage the dorsal aspect is brown; the feathers internally retaining a bluish tinge. The sky blue is still retained on the shoulders, the wing coverts, and margins of the quills of the wings and tail; chin white, with a fine blue streak from each angle of the mouth, lost upon the breast, which is pale brown with indistinct bluish spots; belly and vent white.

F. nivalis. Snow bird.
F. hudsonia of Wilson!
F. hyemalis of Audubon!
Junco hyemalis. Linn.! Baird!

V.S.P. ET V. Bill and legs pale; eggs 3 to 5, green, spotted and speckled with cinereous; irides black.

Dorsal aspect. Greyish black; wing feathers blackish brown; Primaries edged with white; secondaries with brown on the outer vanes, and all more or less edged with white on their inner vanes; tail square; two lateral feathers, and outer vane of 3rd white; Centre feathers blackish brown.

Ventral aspect. Like the dorsal, except the belly, vent, and tail coverts which are white; wing coverts pale grey, edged and tipped with white.

2nd and 3rd primaries equal; 1st shorter than 5th. Length $7\frac{1}{4}$ inches; alar breadth $8\frac{1}{2}$ inches.

F. Pennsylvannica. White-throated Sparrow.
F. albicollis of Wilson!
Zonotrichia albicollis. Gmel.! Baird!

V.S.P. Upper mandible bluish horn colour; lower one, legs and feet pale flesh colour; eggs unknown.

Dorsal aspect. Crown and nape of neck black, divided in the centre by a line of white, and bordered laterally by another line of white, which becomes yellow between the nostrils and the eye, and black behind the eye; back with the scapulars blackish brown broadly edged with chestnut; greater and smaller wing coverts brown tipped with white, causing a couple of bars across the shoulders; tail square, long, glossy chestnut, edged with a lighter tint; primaries and secondaries brown, the former edged with whitish, the latter broadly with chestnut.

Ventral aspect. Cheeks, breast, and flanks lead colour, approaching to brown on the last mentioned situation; belly and tail coverts, with a spot upon the throat white.

1st, 2nd and 3rd primaries subequal. Length $6\frac{1}{4}$ inches; alar breadth $8\frac{1}{2}$ inches; length of tail $2\frac{1}{2}$ inches.

F. melodia. Song Sparrow.
Melospiza melodia. Wilson! Baird!

V.S.P. ET V. Upper mandible bluish horn colour; lower one pale; legs and feet pale flesh colour; eggs 4 to 5, greenish white mottled with brown.

Dorsal aspect. Crown chesnut, divided in the centre by a greyish streak; scapulars blackish brown, broadly edged with chesnut; rump chesnut; tail square, blackish brown along the shafts and broadly edged with chesnut; primaries like the tail; secondaries blackish brown, with broad edgings of chesnut and tipped with the same.

Ventral aspect. A line over the eye as far as the auriculars grey; auriculars chesnut; chin, belly, and vent white; on either side of the throat a triangular spot of blackish brown, and a similar one in the centre of the breast, most conspicuous when the feathers are a little separated; the other parts of the breast and flanks streaked with chesnut.

4th primary longest; 3rd and 5th subequal; 2nd and 6th subequal; 1st equal to 7th. Length 5¾ inches; alar breadth 7 inches. One of the first immigrants that visit us.

With regard to this bird, "the song sparrow," whose nests are built in the immediate contiguity of dwellings, and near every thoroughfare, the following anecdote was told me by Mr. Hunter, the taxidermist to the Natural History Society: On one of his walks to the mountain, close to the footpath of the road leading in that direction, he discovered the nest of one of these birds, covered at the time with a dry leaf. Buildings were being erected in the neighbourhood. Next day on returning to the spot, he found that shavings occupied the place previously used by the leaf, which most carefully concealed the young ones. The colour of the shaving or chip was about that of the young birds at that period of their growth. On visiting next day the nest, the young birds escaped from it. In this instance the instinct of the bird exhibited itself in the employment of a material for the concealment of its nest, the least likely to attract observation from the fact of the erection of a building in the neighbourhood.

F. Canadensis. The Tree Sparrow.
F. arborea of Wilson.
Spizella monticola. Baird!

V.S.P. Upper mandible and tip of lower one black; the remainder with the legs and feet pale; irides deep hazel; eggs 5 pale brown mottled with dark brown.

Dorsal aspect. Crown bright chesnut, the feathers faintly tipped with whitish; nape of neck mixed chesnut and grey; back and scapulars blackish brown edged with pale brown; rump pale brown; smaller wing coverts grey tipped with white; great wing coverts chesnut on the outer vanes, black on the inner and broadly tipped with white, causing an appearance of a couple of bars; primaries and secondaries brown, edged with white on the outer vanes of the former, and with pale brown on the outer vanes of the latter; tail square, brown, minutely edged with white on both outer and inner vanes.

Ventral aspect. A line from eye to nostrils white, changing above the eye to grey, which passing between the auriculars and chesnut crown, is lost over the sides of the neck; chin and upper part of throat, belly, vent, inner wing and tail coverts white; remainder of the throat and breast ashy grey; in the centre of the breast a black spot, most conspicuous when the feathers are a little removed.

1st and 6th subequal; 2nd and 4th equal; 3rd longest and very little longer than 2nd and 4th. Length 6½ inches; alar breadth 9 inches; length of the tail 2¾ inches.

F. socialis. The Chipping Sparrow.

Spizella socialis. Wils.! Buon.! Baird!

V.S.P. Bill black; legs and feet pale flesh colour; irides deep hazel; eggs 4 to 5, greenish blue mottled with dark and light brown.

Dorsal aspect. Frontlet black; crown bright chesnut; back, scapulars and wing coverts black, broadly margined and tipped with brown; on the scapulars the brown partakes of a chesnut tinge; rump grey; primaries, secondaries and tail brown; the secondaries edged with chesnut brown on the outer vanes, and the primaries with white on the outer vanes; tail minutely edged with faint white.

Ventral aspect. Chin, throat, belly and vent white; breast, sides of neck and cheeks ashy grey; a line from the nostrils above the eye white; flank whitish grey.

2nd primary longest; 3rd next; 1st shorter than 4th but considerably longer than 5th. Length 5 inches; alar breadth 7½ inches.

F. leucophrys. White-crowned Finch.

F. leucophrys of Wilson.

Zonotrichia leucophrys. Forster! Sw.! Baird!

V.S.P. Bill, legs and feet pale brown; irides hazel; eggs 4 to 5, chocolate or dusky colour.

Dorsal aspect. Crown of head white, bordered laterally, anteriorly and posteriorly by a broad black line; a line over the eye white; nape of neck ashy grey; interscapular region with the scapulars pure brown tipped with greyish white; rump and tail coverts greyish brown; small wing coverts brown tipped with white; great wing coverts blackish brown margined broadly with chesnut on the outer vanes and tipped with white; primaries and tail cinnamon brown; outer vane of the lateral tail feathers pale; outer vanes of all the primaries edged with white, most conspicuous on the 2nd and 3rd; secondaries clove brown, broadly margined with chesnut on the outer vanes and tipped with white; tail square.

Ventral aspect. Chin and belly white; throat and breast ashy grey; flanks and tail coverts pale ochreous.

3rd primary longest; 2nd subequal to 3rd; 1st shorter than 5th. Length 8 inches; alar breadth 11 inches; length of tarsus and middle toe together 1 inch 10 lines.

F. graminea. Grass Finch.
F. graminea of Wilson!
Pooecetes gramineus. Gmel.! Baird!

V.S.P. Upper part of upper mandible brownish; lower one, legs and feet pale flesh colour; irides hazel; eggs 4 to 5, whitish mottled and blotched with reddish brown at their larger ends.

Dorsal aspect. Crown, neck, both scapulars, and rump clove brown, margined and tipped with dusky brown; smaller wing coverts bay on their outer vanes; primaries, secondaries and tail brown; the first edged with white on their outer vanes; the lateral tail feathers white except a brown streak on the inner vane; a white spot towards the tip of the second.

Ventral aspect. Chin, belly, vent, and tail coverts pure white; throat, cheeks, breast and flanks streaked with brown.

2nd primary longest; 1st and 3rd subequal, and very little shorter. Length $6\frac{3}{4}$ inches; alar breadth 10 inches; tail subfurcate.

F. tristis. American Goldfinch. (Chadronnée).
Carduelis Americana of Edwards.
Chrysometris tristis. Linn.! Bon.! Baird!

V.S.P. ET V. Bill brownish orange; legs and feet pale flesh colour; irides deep hazel; eggs 3 to 5, white, mottled at their larger ends with yellowish brown and subdued lavender purple.

Summer plumage. Dorsal aspect. Crown black; neck, dorsal region, rump and scapulars gamboge yellow; tail coverts and smaller wing coverts white; shoulders black; greater wing coverts and secondaries jet black tipped with white; primaries wholly black; tail square, black, with a white spot at the extremity of each [illegible] vane.

Ventral aspect. Tail and wing coverts white; all the other parts bright gamboge yellow.

Winter plumage. Dorsal aspect. Brownish olive; paler on the rump; greater wing coverts and secondaries tipped with brownish olive, which also supplies the white spots of the tail.

Ventral aspect. Chin yellow; breast and flanks pale brownish olive; belly and vent soiled white.

2nd primary longest; 1st and 3rd equal. Length 4½ inches; alar expanse 7½ inches.

F. pinus. Pine Finch.
Chrysometris pinus. Wils.! Bon.! Baird!

V.S.P. Bill brown; legs and feet purplish black; irides hazel; eggs unknown.

Dorsal aspect. Crown, neck, dorsal region, scapulars and rump clove brown, with broad light brown emarginations to the feathers, causing a dusky appearance; greater and smaller wing coverts clove brown edged and tipped with olive brown; primaries and secondaries blackish brown, the former edged with yellow on their outer vanes, the latter edged and tipped with olive brown, and a gamboge yellow spot on the outer vane near the quills, concealed by the greater wing coverts; tail subfurcate yellow at the quills, the remainder blackish brown.

Ventral aspect. Chin, breast, belly, flanks, and tail coverts clove brown, broadly edged and tipped with soiled white; vent soiled white.

2nd primary longest; 1st subequal to 2nd; and 3rd scarcely shorter than the 1st. Length 4¼ inches; alar breadth 7 inches.

F. linaria. Lesser Red Poll.
Linaria rubra minor. Ray!
Linaria minor. Ray!
Aegrothus linaria. Linn.! Baird!

V.S.P. Bill horn colour; legs and feet black; irides hazel; eggs 5, bluish white spotted with red.

Dorsal aspect. Crown shining lake colour; neck, back and scapulars dusky brown edged with flaxen; on the rump the tips are almost white; great and small wing coverts clove brown tipped with white: wings and tail brown, minutely edged with white on the outer vanes of the primaries, and broadly on the outer vanes of the three last secondaries; tail subfurcate.

Ventral aspect. Chin brownish black; sides of throat, breast, and flanks like the back; belly and vent white. This description is taken from a female. In the male the "ventral aspect and crown are pale crimson approaching to white on the vent; crown deep crimson; frontlet and chin black."

2nd primary longest; 1st and 3rd equal. Length $5\frac{1}{4}$ inches; alar breadth 9 inches.

F. iliaca. Ferruginous Finch.
Passerella iliaca. Baird!

V.S.P. Upper mandible brownish horn colour; lower one pale flesh with a black tip; legs and feet pale flesh colour; eggs 5, mountain green mottled with brown.

Dorsal aspect. Head, scapulars, and back dark greyish brown, brightening into ferruginous on the rump and wing coverts, the latter of which are tipped with ferruginous white; primaries and secondaries umber brown; the outer web of the 2 first primaries edged faintly with white; the outer webs of all the others, as well as the scondaries, with bright ferruginous; the 3 or 4 last secondaries broadly on outer webs of the tail feathers ferruginous, inner webs umber brown; tail coverts ferruginous.

Ventral aspect. Lower eyelid white; cheeks ferrugineous; chin, throat, breast and flanks white, with numerous triangular spots of bright ferruginous, most numerous on the breast; middle of the throat, belly, vent, tail and wing coverts white.

3rd primary longest; 2nd and 4th equal; 1st a little shorter than the 5th. Length 7 inches; alar breadth $9\frac{1}{2}$ inches.

F. ludoviciana. Rose-breasted Grosbeak.
Guiraca (Goniaphea) ludoviciana. Linn.! Sw.! Baird!

V.S.P. Bill white horn colour; legs and feet bluish; irides hazel; eggs 4 to 5, white, spotted brown.

Dorsal aspect. Crown and nape of neck black; scapulars and dorsal region as far as the rump black, edged with olivaceous; rump and tail coverts white, some of the former tipped with brown; greater and smaller wing coverts blackish brown tipped with white; tail black; the three lateral feathers with a white spot occupying more than half the inner vanes.

Ventral aspect. Chin feathers black, minutely tipped with lake; throat, and upper part of the breast, and inner wing coverts rich lake; the lake on the throat occasionally descending in a medial line on the breast; flanks white with a few black spots; belly, vent and tail coverts white.

The young bird and female are varied "with pale flaxen, dark olive, and whitish." In the female there is no lake on the breast or wings; but the young male has a roseate tinge on the flaxen throat, and the lake wing linings as perfect as in the old male; its upper mandible also is brownish.

2nd primary is longest; 1st a little shorter than the 3rd, and of equal length with the 4th. Length 8 inches; alar breadth 10½ inches.

F. purpurea. Purple Finch.

Carpodacus purpureus. Gm.! Gray! Baird!

V.S.P. Bill brownish horn colour; legs and feet brownish white; irides hazel; eggs unknown.

Dorsal aspect. Shining lake colour; most varied on the head, and neck, and rump; the centre of the dorsal feathers being brownish black; wings and tail dusky brown, edged on the outer vanes with lake; greater and smaller wing coverts blackish brown edged with lake.

Ventral aspect. Chin, throat, breast, and sides of the belly, rich lake colour; vent and tail coverts white, tinged rosaceous.

2nd primary longest; 1st and 3rd subequal; tail subfurcate. Length 6½ inches; alar expanse 8½ inches; crest erectile at pleasure.

"Female and young varied with pale brown, and dusky without crimson; beneath yellowish white, spotted with dusky brown."

Genus Pyrrhula.

Gen. char. Bill short, gibbous; tip of upper mandible deflected over the lower; nostrils basal, lateral, rounded, and usually concealed by the frontlet feathers; tarsus shorter than the middle toe; all of them free; 4th primary longest; tail subrotund or square; tongue thick and fleshy.

P. enucleator. Pine Grosbeak.—Canadian Bulfinch.

Loxia enucleator of Wilson.

Pinicola Canadensis. Baird!

V. S. P. ET V. Bill, legs and feet brownish horn colour; irides hazel; eggs 4 or 5, white.

Dorsal aspect. Crown, nape of neck and rump, bright lake colour; dorsal region and scapulars blackish brown, broadly edged and tipped with lake; greater and smaller wing coverts black, broadly edged and tipped with white on the outer vanes; tail coverts blackish brown, tipped with lake colour; primaries, secondaries and tail, blackish brown; the primaries edged with lake colour, the secondaries with white on the outer vanes; the outer vanes of the tail feathers edged with brownish lake.

Ventral aspect. Chin, throat, breast, cheeks, and sides of the belly, lake colour, fainter than on the back; middle of the belly and vent feathers, dusky grey.

3rd primary longest; 2nd next; 1st shorter than the 4th. Length 9¼ inches; alar breadth 14 inches.

The young bird is wholly dusky beneath and on the back, the crown of the head and rump being olivaceous brown. The female possesses the same characteristics. The young bird of the second year has the inner parts and the rump with a lake tinge: which is also conspicuous on the ventral aspect.

Genus Icterus.

Gen. char. Bill longer than, or as long as the head, conical, unnotched, grooved internally, and slightly flattened towards the apex, compressed in the middle; nostrils basal, lateral; tarsus equal to or longer than the middle toe; 3rd and 4th primaries longest.

Icterus phœnicius. Red-winged Blackbird.
Sturnus prædatorius of Wilson.
Agelaius phœnicius. Baird!

V.S.P. Bill, legs and feet black; irides hazel; eggs 3 to 5 white, tinged with blue, streaked with purple and dark brown.

Whole dorsal and ventral aspects, including the primaries, secondaries and tail, shining jet black; small wing coverts and shoulders rich scarlet, except the lower row, which fades to orange.

3rd primary longest; 2nd and 4th equal; 1st and 5th equal. Length 4½ inches; alar breadth 13 inches.

The female has the dorsal aspect black, with grey edgings to the feathers; the ventral aspect greyish white, streaked with black; the throat occasionally with a scarlet tinge. The young bird has the dorsal feathers edged with brownish; a white line over the eye; the smaller wing coverts brownish red; and the ventral feathers black edged with grey.

Sub genus Emberizoides.

Sub gen. char. In these the bill is short, conic, straight, not dilated at the base, and not so pointed as in the Fringilla tribe.

The genus bear a great resemblance to the finches, but differs from them in their habits.

I. agripennis. Rice Bunting.—Goglue.—Bob-o-link.
Emberiza oryzivora of Wilson.
Dolichonix oryzivorus. Baird!

V.S.P. ET V. Bill horn colour; legs and feet pale flesh colour; irides hazel; eggs 5 to 6, dull white, inclining to olive, blotched with lilac and rufous brown towards the larger end.

Dorsal aspect. Front and crown of head black, the feathers sometimes tipped with rufous white; back of head, and neck rufous white; interscapular region black, the feathers edged with rufous white; rump brown; tail coverts brownish white; scapulars white, edged with rufous white; small wing coverts and great wing coverts black, the latter edged on the outer vanes with rufous white; primaries, secondaries and tail brownish black, edged on the outer vanes and tipped with brownish white; tail cuneiform, the feathers acuminate, the centre ones most so.

Ventral aspect. Black, the feathers tipped with rufous white, most conspicuous on the breast and belly; cheeks and auriculars black.

2nd primary longest; 1st next; the others graduated. Length $6\frac{1}{3}$ inches; alar breadth $9\frac{1}{2}$ inches.

The female and young male resemble one another, they are varied with brownish black and brownish yellow above, while a dull yellow prevails on their ventral aspects. The winter plumage of the male resembles that of the summer female, but on the whole yellower. This bird is the famous Butter Bird of the West Indies, which is there esteemed so great a delicacy. The tarsus and middle toe of this bird are equal in length.

I. pecoris. Cow Troopial or Cow Blackbird.
Emberiza pecoris of Wilson.
Molothrus pecoris. Baird!

V.S.P. Bill, legs and feet black; irides white; eggs 3 to 5, greenish white, spotted with olive brown.

Head, neck, and throat above and below, rusty brown, the rest of the dorsal and ventral aspects black, with a steel blue reflection; wings and tail blackish brown.

1st primary longest; the rest graduated; tail square. Length 6 inches; alar breadth 11 inches.

The female is wholly sooty brown. The young bird resembles the mother but has a spotted breast.

Genus Sturnus.

Gen. char. Bill conical but long, depressed, obtuse; base of upper mandible projecting on the forehead; nostrils broad, lateral, semi-closed by a membrane; tongue sharp, bifid; exterior and middle toes connected at base; 2nd and 3rd primaries longest.

S. Ludovicianus. Meadow Lark or Starling.
Alauda magna of Wilson!
Sturnella magna. Baird!

V.S.P. Upper mandible horn colour; lower one, with the basal and distal thirds horn colour, centre white; legs and feet pale flesh colour; eggs 4 to 5, white tinged with blue spotted with reddish brown.

Dorsal aspect. Three streaks of white separated by two of brownish black on the crown of head; neck, dorsal region, rump, tail and wing coverts, with scapulars brownish black, the feathers edged with chestnut, which is terminated by a white margin; primaries and secondaries brown, edged with brownish white on the outer vanes of the former, and barred and edged with the same colour on the outer vanes of the latter; tail rounded; 3 lateral tail feathers wholly white except towards the end of the outer vanes; 4th brownish black, with a white streak down the centre; the centre feathers brown, edged with whitish brown with imperfect bars; a streak from the orbit to nostrils gamboge yellow; behind the eye a black line terminating behind the auriculars which are grey; cheeks white.

Ventral aspect. Chin, throat, breast and belly, gamboge yellow, with a crescent of black on the chest, and a triangular spot of the same colour on each side of the throat; flanks white, spotted with black; vent dirty white; tail coverts brownish white with a black streak in the centre of each feather.

1st and 2nd primaries subequal; some of the secondaries elongated, nearly equal in length to the 3rd primary. Length 9¾ inches; alar breadth 14 inches. The young bird has the yellow fainter and the crescent of a duller black. This is a very rare bird in this district, but is occasionally met with.

Genus Corvus.

Gen. char. Bill thick, compressed at the sides, stout, and bent towards the apex; nostrils basal, open, and concealed by the projecting bushy feathers of the frontlet; toes like the other genera of this family, but free; middle toe shorter than the tarsus; 3rd and 4th primaries longest; wings long and acuminate.

C. corax. The Raven.
C. carnivorus. Baird!

D.C. Bill, legs and feet black; irides with two circles, greyish white and cinereous brown; eggs 5 to 6, muddy bluish green, spotted with olive brown.

Dorsal and ventral aspects, glossy black with steel blue reflections; tail much rounded extending beyond the wings; 3rd primary longest. Length about 26 inches. A rare bird in the district of Montreal, though occasionally met with.

C. corone. The Common Crow.
C. Americanus. Baird!

V.S.P. Bill, legs and feet black; irides hazel; eggs 2 white.

Dorsal and ventral aspects. Glossy black, with purple reflections on the back, and sombre on the vent. Tail rounded a little, extending but little beyond the wings. The feathers acute. 1st primary very short; in length equal to 9th. 4th primary longest. Length $18\frac{1}{2}$ inches. Very common, often hybernating with us.

Subgenus Garrulus.

Sub. char. Bill shorter and straighter than with the crows. Upper mandible somewhat inflected at tip; lower one keeled; tail more or less cuneiform; feathers of head erectile.

C. cristatus. Blue Jay.
Cyanura cristata. Baird!

V.S.P. Bill and legs with the feet black; irides hazel; eggs 5, dull olive, spotted brown.

Dorsal aspect. Frontlet, and line rising perpendicularly from the nostrils, black; streak from the eye passing above the auriculars and uniting on the nape of the neck jet black; crest, small wing and tail coverts sky blue; dorsal region sky blue tinged with purple; tail long, subrotund, sky blue, with 10 or 12 bars of black on the centre feathers, the bars diminishing in number to the lateral feathers, on which they are obsolete, or at least imperfect; all the feathers except the centre ones broadly tipped with white; greater wing coverts sky blue, barred black and tipped with white; primaries brownish black on the inner vanes, and sky blue on the outer; secondaries, except the three or four last which are marked on both vanes, like the great wing coverts, the others brownish black on the inner vanes, and sky blue barred with black on the outer.

Ventral aspect. A semicircular spot over the eye, chin, throat and auriculars bluish white tinged with blue, darkest on the throat at the mesial line; a crescentic spot on the breast, ascending upwards and terminating behind the auriculars; belly and vent grey, lighter on the vent; wing coverts blue; tail coverts white.

5th primary longest; 6th next; 4th and 7th subequal; 2nd and 9th equal; 1st considerably shorter than the secondaries. Length $11\frac{1}{4}$ inches; alar expanse 16 inches; length of tail $5\frac{3}{4}$ inches; length of bill 1 inch 1 line. A very elegant bird. The whole dorsal aspect being very glossy.

C. Canadensis. Canada Jay.

Perisoreus Canadensis. Baird!

V.S.P. Bill, legs and feet black; irides hazel; eggs 3 to 4, lilac.

Dorsal aspect. Frontlet, and front half of the crown dirty white, changing to blackish brown on the hind part of the crown and nape of the neck; back, rump, scapulars and wing coverts, slate grey; primaries and secondaries blackish brown tipped with dirty white, and edged with slate colour on the outer vanes; tail cuneiform, slate grey, approaching lead colour, tipped with soiled white.

Ventral aspect. Auriculars, sides of the throat, chin and throat soiled white, the shafts prolonged in a filiform state beyond the vanes and black, causing a hairy appearance beyond the feathers. This also occurs in the C. cristatus. Breast, belly, wing and tail coverts brownish grey.

5th primary longest; 4th and 6th equal; 3rd a line shorter than the 7th; 2nd shorter than the 8th; 1st shorter than the secondaries. Length 11 inches; alar breadth 16 inches.

Fam. IV. Tenuirostres.

Genus Sitta.

Gen. char. Bill straight, attenuate, awl-shaped and acuminate; upper and lower mandibles recurved from the centre; nostrils basal, lateral, rounded, and concealed by nuchal bristles; tongue horny; feet robust, 3 toes before and 1 behind, exterior connected to the middle at its base; hind toe long with a strong hooked nail; tail of twelve feathers of moderate length, short in some species; 2nd, 3rd and 4th primaries longest.

S. Carolinensis. White-bellied Nuthatch.

S. Carolinensis. Baird!

V.S.P. Upper mandible, and distal half of the lower, black;

basal half of the lower, white; legs and feet pale flesh colour; irides hazel; eggs 5, dull white spotted with brown.

Dorsal aspect. Crown and nape of neck jet black; dorsal region to the rump lead colour; greater and smaller wing coverts black, edged and tipped on their outer vanes with lead colour; primaries and secondaries blackish brown, edged with lead colour on the outer vanes of all, except the three first primaries, the 1st of which is unmarked in any way, and the two next with a white edging about the centre of their outer vanes; tail square, the two centre feathers lead colour, the others blackish brown, with a broad white spot; the outer vane of the lateral feather wholly white.

Ventral aspect. A line from nostrils over the eye, cheeks, sides of neck, (and here bounded by a black line,) chin, throat, breast, belly, and tail coverts white, vent feathers tinged with rusty colour.

2nd primary longest; 3rd next; 4th next; and 1st shorter than 5th. Length 5½ inches; alar expanse 9½ inches. The young bird is stated to have a lead coloured head.

S. Canadensis. Red-bellied Nuthatch.

S. Canadensis. Baird!

V.S.P. Bill black, with the exception of the basal half of the lower mandible; legs and feet dusky, greenish yellow; eggs unknown.

Dorsal aspect. Crown and nape of neck jet black; a white line from the nostrils passes over the eye above the auriculars and is lost upon the shoulders; this is succeeded by a black line from the angle of the mouth and ending in the same place; auriculars white; dorsal region, rump, scapulars, and wing coverts lead colour; primaries and secondaries pale brown, faintly margined on their outer vanes with lead colour; tail short, square; two central feathers lead colour, the others blackish brown, with a white spot like a bar commencing about the centre of the lateral feathers, and terminating at the tip of the 4th.

Ventral aspect. Chin white; throat, breast, and belly, with vent feathers, rusty coloured.

2nd primary longest; 1st and 4th equal. Length 4½ inches; alar breadth 7½ inches. The young bird with a plumbeous heads.

Genus Certhia.

Gen. char. Bill more or less long, with a greater or less curvature, triangular, compressed, slender and acuminate; nostril.

basal, naked, horizontally perforated in a membrane and half closed by a membrane; feet slender; inner toe free; outer toe connected at base to inner one; claws considerably curved, that of the hind toe longest; tail graduated, elastic and acuminate; 3rd and 4th primaries longest.

C. familiaris. Brown Creeper.
C. Americana. Baird!

V.S.P. Upper mandible dark; lower one pale flesh colour; legs and feet dusky; eggs 7 or more, cinereous, spotted with reddish yellow and streaked with dark brown.

Dorsal aspect. Prevailing tint ferruginous, darkest on the head, mixed with white on the interscapular region, scapulars, and wing coverts, and pure ferruginous on the rump; tail cuneiform, drab colour, the feathers acuminate; wings rounded, pale brown, with a single white bar across their middle tinged with ferruginous, and margined faintly with brownish white on the outer vanes.

Ventral aspect. *French white; the feathers of the whole* body exceedingly silky and long.

3rd primary longest; 2nd shorter than 4th. Length 5 inches; alar expanse 7 inches. Tail about two lines longer than the body.

Genus Trochilus.

Gen. char. Bill long, straight or more or less arcuate, slender, the base depressed, and as wide as the forehead, point acuminate; nostrils linear, basal, covered by a membrane; tongue, long, extensible, bifid and tubular; legs very short; tarsus shorter than middle toe, more or less feathered; front toes nearly free; wings acute; 1st primary longest.

T. colubris. Ruby-throated Humming Bird.
T. colubris. Baird!

V.S.P. Bill, legs and feet dusky black; irides deep hazel or black; eggs 2, white.

Dorsal aspect. Except the wings and tail rich golden green, darkest on the head; wings and tail brownish black; the former falciform, the latter furcate.

Ventral aspect. Chin, throat and cheeks rich ruby colour, the feathers somewhat erectile; shoulders, breast, belly, and coverts pale brown, in the first mentioned situation, tinged with golden green; vent white.

1st primary longest; the others graduated. Length $3\frac{1}{8}$ inches; alar expanse 4 inches. The female has a similar dorsal aspect to the male, but less brilliant; her ventral aspect is white, the feathers faintly edged and tipped with rufous, and the three lateral tail feathers tipped with white. In the young bird the throat strongly inclines to yellow. In the adult males which I have seen, I have not detected "the three outer tail feathers rusty white at the tips," as according to Nuttal.

2nd division of Passerinæ, in which the external and middle toes are united to their penultimate articulation.

Fam. Syndactyla.

Genus Alcedo.

Gen. char. Bill quadrangular, long and straight, edged, acuminate; nostrils basal, lateral, oblique, almost wholly closed by a naked membrane; legs short, naked above the knee for a considerable space; tongue short and fleshy; outer toe connected to the middle as far as the second joint, and the inner to the middle as far as the first joint. 3rd primary longest.

A. alcyon. Belted Kingfisher.
Ceryle (Megacerile) alcyon. Baird!

V.S.P. Bill black, pale at the tip; legs and feet bluish; claws black; irides hazel; eggs 6, white.

Dorsal aspect. A white spot between the orbit and nostrils; crest, nape of neck, interscapulary region, scapulars, small and greater wing coverts, (which are also faintly tipped with white,) and rump, bluish slate colour; primaries and secondaries black; the former with half of their inner vanes white, and barred with white on the collateral portion of the outer vane; the four or five last ones edged on the outer vane with bluish slate colour and tipped with white; secondaries bluish slate on the outer vanes; black barred with white on their inner vanes, tipped with white except the 4 or 5 last ones which are wholly bluish slate colour; tail square; the two centre feathers bluish slate, with a black streak down their shafts, the others all black, with 11 or 12 narrow bars of white, with a terminal tip of the same colour, and edged with slate blue on the outer vanes.

Ventral aspect. Chin, throat, and sides of neck, belly, vent, wing and tail coverts white; breast with a slate blue belt reaching from shoulder to shoulder.

3rd primary longest; 2nd next; 1st about a line shorter than the 4th. Length 13¼ inches; alar expanse 19¼ inches. Length of bill from angle of mouth 2 inches and two thirds. The female has the sides and a belt on the breast ferruginous, and the slate blue duller.

Ord. III. Scansoria.

Genus Picus.

Gen. char. Bill more or less long, straight, and cuneiform at the tip; nostrils basal, open, covered by bristly feathers; tongue round, extensile, sharp and rigid at the point, and armed with stiff reversed bristles; two toes before and generally two behind; feet robust; anterior toes connected at their base; posterior ones divided; 3rd and 4th primaries longest; two lateral tail feathers very short; the shafts of all the tail feathers mucronate, strong, and very rigid.

1st Section.—Tetradactyla.

Subdivision 1. With the bill curved, cuneiform, under mandible not carinate.

P. auratus. Golden-winged Woodpecker.
Colaptes auratus. Baird!

V.S.P. Bill dusky horn colour; legs and feet pale bluish; irides hazel; eggs 6, white.

Dorsal aspect. Crown of head cinereous brown tinged with olivaceous; posterior part of the crown with scarlet crescentic streak; nape of neck, interscapular region, scapulars, greater and smaller wing coverts, and outer vanes of the secondaries, umber coloured barred with black; rump white; tail coverts white barred with black; outer and inner vanes of the primaries, and inner vanes of the secondaries black, with rudimentary white bars on the outer vanes of the 3rd and upwards; tail cuneiform, the feathers acuminate black; the outer vane of the lateral ones barred with white, the bars rudimentary on the outer vanes of the second; the shafts of the quills of the wings and tail golden yellow.

Ventral aspect. Cheeks, and around the eye, auriculars, chin, and throat, cinnamon colour approaching to fawn, deepening into cinereous on the sides of the neck; moustaches and crescent on the breast jet black; belly, vent, and sides of flanks with round black spots on a white ground in the two former situations, and on a cinnamon ground in the two latter; tail coverts white with black bars; wing coverts yellow; inner surface of wing and tail tinged with golden yellow, changing to black towards the tips and edges of the feathers; the spots on the belly and vent are orbicular, those of the flanks and sides cordiform approaching to reniform.

1st primary very short; 2nd shorter than the 8th; 4th and 6th equal; 5th longest. Length 11½ inches; alar breadth 16½ inches. The young bird is dull grey, and wants the red and black crescents. The female wants the black moustaches, but has the other two distinctive marks. A most elegant bird.

Subdivision 2. *With the bill straight, and carinate above and below.*

P. erythrocephalus. Red-headed Woodpecker.
Melanerpes erythrocephalus. Baird!

V.S.P. Bill white at the base, bluish towards the end; legs and feet bluish; irides hazel; eggs 6, white spotted with red.

Dorsal aspect. Head and neck crimson; dorsal region including the scapulars and wing coverts jet black; primaries and tail black, the three lateral feathers of the latter with white tips; secondaries and rump white.

Ventral aspect. Chin, cheeks, sides of neck, and breast crimson like the head; belly, flanks, vents and tail coverts white.

3rd primary longest; 2nd next; 1st next. Length 9 inches; alar expanse 15½ inches.

P. varius. Yellow-bellied Woodpecker.
Sphyrapicus varius. Baird!

V.S.P. Bill black; legs and feet bluish; irides hazel; eggs 4, white.

Dorsal aspect. Crown of the head crimson, bordered posteriorly by a crescent of black; nape of neck yellowish white; interscapular region and rump varied with white, yellowish white, and black spots and bars; scapulars and small wing coverts black; a few of the greater wing coverts white; tail coverts with their outer vanes black, their inner ones white; primaries and secondaries black, tipped and barred with white; tail cuneiform; the two lateral feathers edged with white on the outer vanes, and tipped with the same colour; a streak of white along the inner vanes of the central feathers with two or three black spots.

Ventral aspect. A yellowish white line over the eye terminating on the nape of the neck; from behind the eye a black line including and terminating behind the auriculars; from the nostrils a yellowish white streak passes below the eye and terminates on the shoulders; from the angle of the mouth a black streak passes down on each side of the throat and terminates on the black orbicular spot which invests the breast; the black streak on either side invests the crimson chin and throat; the black breast is bounded by a gamboge yellow streak which commences on the shoulders, meets at the lower part of the breast, and is thence continued in the mesial line to the belly and vent; sides of the breast, and flanks yellowish brown streaked with black; inner wing and tail-coverts whitish yellow.

2nd and 3rd primaries subequal and longest; 1st considerably shorter than the 4th. Length $8\frac{1}{3}$ inches; alar expanse 13 inches.

P. villosus. Hairy Woodpecker.

P. (Trichopicus) villosus. Baird!

V.S.P. Bill, legs and feet bluish horn colour; irides hazel; eggs 5, white.

Dorsal aspect. Frontlet feathers brownish white; crown black, bordered posteriorly by a crimson crescent; line from the nostrils over the eye white, terminating at the crimson crescent; line from the eye passes backwards, including the auriculars, and meeting its fellow on the nape of the neck, forms a black border to the crimson; white sides of the neck separated in two portions by a black streak commencing below the angle of the mouth and terminating on the shoulders; nape of neck black; interscapular region and rump black, with a white irregular streak down the centre: scapulars black; greater and smaller wing coverts black, with a white spot near the tips of the outer vanes; the two lateral tail feathers white; the third black with a dirty white tip; the others all jet black with shining shafts; primaries and secondaries black barred with white.

Ventral aspect. White, soiled towards the vent.

3rd and 4th primaries subequal and longest; 2nd and 5th subequal; 1st shorter than the 6th. Length $9\frac{1}{4}$ inches; alar expanse 14 inches. The occipital band in the female is black.

(To be continued.)

CORRESPONDENCE.

AN ENTOMOLOGICAL GRAVE-DIGGER.

To the Editor of the "Canadian Naturalist."

SIR,—As I was sitting this morning on the lower step of my veranda, my gaze fixed listlessly, during the noontide heat, upon the gravel-walk before me; "thinking," I verily believe, "of nothing," or at most, entertaining a dreamy impression that I was becoming a focus for the concentration of the sun's rays—my eyes were suddenly attracted to an insect whose motions very soon riveted my attention.

I at once perceived that it belonged to the order *Hymenoptera*, but even now that I have the specimen in question before me, I am afraid to name its *genus*: it is, however, similar to the *Tenthredo scrophularia*, if it is not actually that insect. The accompanying sketch may enable you to arrive at a decision on this point: it is the natural size, the length being exactly five lines.

The little creature, when I first caught sight of it, had already commenced, within four feet of the spot on which I was seated, its work of excavation; for as I looked it disappeared, and shortly afterward returned to the surface of the ground tail first; and running backward over a tiny mound it had previously made, deposited a grain of gravel fully as large as its own head *outside* the mound, with the evident intention that it should not roll back again into the cave it was in process of forming. This operation was continued with great rapidity; and ever as it re-entered the orifice I saw minute particles of sand fly upward, impelled purposely by its descending feet.

The care with which the insect distinguished between the larger and the smaller grains was wonderful; those only whose gravity might have caused them to roll down again, had they been placed below the apex of the mound on the side on which the work was carrying on, were conveyed *beyond* the mound; the smaller grains were added to the mound itself without much apparent discrimination.

After a time the work was evidently completed to the satisfaction of the laborer, for it flew away to the grass-edging of a flower-border distant about six feet from the cave, and immediately emerged from thence, dragging after it, for it was running backward, the body of a large spider not long dead,—a spider whose bulk was at least three times as great as that of its intending sexton. On arriving within twelve inches of the sepulchre the insect left the corpse, and hastened thither to ascertain, as I cannot doubt, whether or not the orifice was large enough for its admission: it was not so, and the grave-digger resumed his work enlarging, though but very slightly, showing thus how true his eye was, the opening he had made. Returning to the spider he dragged it onward, and, still running backward, pulled it after him within the hole; and I noticed that so nice had been the calculation, there was exactly sufficient space for the passage of the body—sufficient, but not a hair's-breadth to spare.

The insect soon once more emerged, and immediately commenced filling in the grave, a work he speedily though carefully accomplished. And when that work was completed, he ran round and round with great celerity upon the surface, scattering the gravel in all directions with his feet, with the undoubted object of obliterating every, the faintest mark by which his *cache* might be discovered: and so effectually was this portion of his operation executed, that half an hour subsequently I was unable, though I searched diligently and anxiously, assisted too by eyes far keener than my own, eyes that had also watched the whole transaction, to find it out myself.

Meantime, having sent for my net, I, not without some feelings of compunction, captured the little workman, and putting him to death by the shortest possible method, made a sketch of him for future reference.

Now, what was the object of the little creature in conveying beyond the ken of other insects the booty it had discovered? My first impression was that it was an *Ichneumon*, and that it was about to deposit its eggs within the body of the spider; but *Ichneumons*, I believe, invariably make use of living caterpillars for that purpose; and after having effected my capture, I could discover no trace of an *ovipositor*. I imagine, therefore, that it must have intended to make a meal, or many meals off the carcase: but why it should have expended so large an amount of time, and given itself so much trouble on that account, I confess I am unable to determine.

A reflection, and I conclude. How slender is the line of demarcation separating instinct from reason! and how marvellous the Creative Power that could have imparted to an insect so insignificant, faculties such as I have attempted, however feebly, to describe!

I have the honour to be, Sir,
Your most obedient servant,
VINCENT CLEMENTI, B. A., Cantab.

Peterboro', C. W.,
26th July, 1862.

NOTE.—The insect referred to by our correspondent was probably one of the fossorial wasps or Sand-wasps, some species of which have precisely the habit described. Their object is to provide foot for their young; their eggs being deposited with the spiders or caterpillars which they bury, and the larvæ subsisting on the provision thus made for them. Were the specimen sent to us, no doubt the species might be determined. EDS.

MISCELLANEOUS.

Occurrence of the Blue Grosbeak (Guiraca cœrulea, Swainson) at Mille Vaches, Lower St. Lawrence.

Canadian Ornithologists will be gratified to learn that the beautiful Blue Grosbeak is now for the first time added to the list of birds visiting Canada:—On the 7th of May both sexes of the species were noticed by Mr. Peverley, sen., of Mille Vaches; they were accompanied on the same tree by the little Indigo bird. Mr. Peverley is continually residing in the vicinity of the primitive forests, where he has good opportunities of observing our feathery visitors, and the unusual occurrence of a bird having such brilliant blue colour at once attracted his attention; he therefore lost no time in securing the male which is stuffed and in his possession. The *habitat* of the Blue Grosbeak is the "more Southern States from the Atlantic to Pacific, south to Mexico." Judging from the season, together with the fact of the female having been noticed, there is good evidence that they intended to build in this country.

Occurrence of the Stone Chat (Saxicola œnanthe. Bechst.) at Beauport, near Quebec.

A single specimen of this pretty bird was procured and stuffed by me; it is now in the Museum of the Smithsonian Institution, Washington. It also forms an addition to Canadian Ornithology.

Occurrence of the Yellow Rail (*Porzana noveboracensis*) *in the vicinity of Quebec.*

Although this handsome little bird is mentionned by Swainson in the "Fauna Boreali Americana" on the authority of Mr. Hutchins who resided on the coast of Hudson's Bay, near the efflux of Severn River, I am not aware that it has appeared in any of the published lists of Canadian birds. It is extremely rare in this latitude, only two specimens have been procured during two years; both were shot by Mr. G. Campbell of the Quebec Customs; one is in his possession, and the other he presented to me, which I stuffed, and is now in the collection of S. Derbishire, Esq.

WM. COUPER, Quebec.

(*From proceedings of the Geological Society of London.*)

On the Geology of the Gold-fields of Nova Scotia. By the Rev. David Honeyman. (Communicated by the President.)

The author, at the request of the Provincial Government Commission for the International Exhibition, made some observations on the auriferous rocks at Allen's and Laidlow's farms, near the junction of the Halifax and Windsor and the Halifax and Truro railways. He found chloritic schist, with vertical auriferous quartz-veins, and a gold-bearing horizontal quartz-vein (the "barrels" of the miners) lying on the schist and overlaid by quartzite and gravel. By the neighbouring railway sections the chlorite-schist is seen to alternate in broad bands with quartzite, and to be associated with granite. The author thinks there is reason to believe that the quartzite may be of Lower Silurian age.

"On some Fossil Crustacea from the Coal-measures and Devonian Rocks of New Brunswick, Nova Scotia, and Cape Breton." By J. W. Salter, Esq., F.G.S., of the Geol. Surv. Great Britain. One of the Devonian fossils is apparently allied to the Stomapods, and is named *Amphipeltis paradoxus* by Mr. Salter; it was obtained by Mr. Hartt and Dr. Dawson near St. John's, where it occurred with plant-remains; another Crustacean fossil from the same locality collected by Mr. Payne, is a new *Eurypterus*, *E. pulicaris*. Other remains of *Eurypteri* have been sent also by Dr. Dawson, from the coal-measures of Port Hood and the Joggins; and with these a new Amphipod, *Diplostylus*, having some characters of alliance with *Typhis* and *Brachyocelus*.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTINS, ISLE JESUS, CANADA EAST, (NINE MILES WEST OF MONTREAL,) FOR THE MONTH OF JUNE, 1862.

Latitude, 45 degrees 32 minutes North. Longitude, 73 degrees 36 minutes West. Height above the level of the Sea, 118 feet.

BY CHARLES SMALLWOOD, M.D., LL.D.

Day of Month.	Barometer—corrected and reduced to 32° F. (English inches.)			Temperature of the Air.—F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.			Horizontal Movement in 24 hours. In miles.	OZONE. Mean amount of, in tenths.	RAIN. Amount of, in inches.	SNOW. Amount of, in inches.	WEATHER, CLOUDS, REMARKS, &c. &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.					6 a. m.	2 p. m.	10 p. m.
1	29.682	29.539	29.583	50.1	83.2	60.5	.277	.846	.307	.75	.75	.71	S.	S. S. W.	S. S. E.	17.80	1.5	....	....	Clear.	C. C. Str. 4.	Clear.
2	608	516	608	44.0	83.6	65.0	.218	.884	.488	.76	.77	.75	S. S. E.	S. S. W.	S. S. E.	0.00	1.5	....	....	Cu. Str. 10.	Hazy.	Hazy.
3	664	810	930	58.4	76.0	62.1	.372	.551	.406	.78	.75	.74	N. N. E.	N. E.	S. by W.	3.90	1.5	....	....	Clear.	C. C. Str. 8.	C. Cum. 6.
4	974	30.085	980	50.0	72.2	55.7	.265	.273	.295	.75	.35	.68	N. E. by E.	S. S. E.	S.	16.11	1.0	....	....	Cirr. Str. 4.	C. C. Str. 4. Im.S.H.	C. C. Str. 8.
5	982	29.855	855	58.0	85.8	66.0	.365	.450	.383	.76	.37	.61	S. S. W.	S. W.	S. W. by S.	15.00	2.0	....	....	Clear.	Clear.	Hazy.
6	777	723	746	52.2	84.2	56.2	.282	.584	.363	.73	.50	.81	N. E by E.	S. E. by E.	N. E. by E.	24.10	1.5	....	....	Hazy.	Hazy.	Cirr. 2. Lunar Corona.
7	693	714	796	44.6	62.4	53.4	.189	.319	.269	.64	.58	.67	N. E. by E.	N. E. by E.	N. E. by E.	125.20	1.5	Inapp.	....	Cu. Str. 10.	Clear. Slight Shower.	C. C. Str. 4.
8	862	898	954	52.5	72.1	55.0	.232	.303	.269	.60	.39	.62	N. E. by E.	N. E. by E.	S.	158.60	1.5	....	....	Cirr. 2.	Cirr. 2.	Clear.
9	891	864	861	56.1	77.8	63.6	.269	.285	.409	.62	.30	.70	S. S. W.	W.	W. S. W.	212.46	2.0	....	....	Clear. Light frost.	Clear.	Hazy.
10	872	796	705	58.4	83.5	67.8	.358	.552	.400	.73	.48	.61	S. W.	S. W.	S. W.	79.00	2.0	....	....	Hazy.	Hazy.	"
11	574	497	465	56.1	93.1	70.1	.262	.800	.557	.59	.52	.77	S. W.	S. W.	S. W.	14.00	2.0	....	....	Clear.	"	"
12	347	307	445	57.4	82.5	65.0	.295	.578	.549	.63	.54	.89	W. by S.	W.	N. E.	226.80	2.5	0.553	....	Clear.	"	Clear. Eclipse of the Moon.
13	593	516	585	62.7	82.1	65.0	.485	.578	.549	.86	.54	.89	N. W.	S. by W.	W. S. W.	97.10	1.5	....	....	"	C. Cirr. 4. So. Ha.	"
14	673	714	727	50.0	64.7	55.8	.309	.396	.355	.85	.65	.84	N. E. by E.	N. E. by E.	N. W. by W.	70.90	1.5	....	....	"	Cu. Str. 4.	C. Cirr. 2.
15	733	872	983	42.2	53.2	40.1	.222	.219	.203	.83	.54	.82	N. N. W.	N.	W. S. W.	188.40	1.5	....	....	"	Cirr. Cum. 4.	Clear.
16	30.144	30.070	30.036	44.6	71.1	46.1	.211	.316	.238	.72	.42	.77	S. W.	W. S. W.	S. S. W.	96.30	1.5	....	....	" Slight frost.	Clear.	"
17	29.935	29.714	29.520	52.1	84.0	71.0	.302	.530	.476	.82	.51	.64	S. S. W.	S. S. W.	S. S. W.	157.74	1.5	....	....	Cu. Cirr. 4.	C. Cirr. 4.	Cu. Str. 4. Distant Lightning.
18	341	324	344	61.5	77.0	60.1	.406	.639	.462	.74	.69	.91	S. W.	S. S. W.	N. N. E.	225.80	3.0	0.104	....	C. C. Str. 4.	C. C. Str. 10.	Rain.
19	482	483	587	51.1	64.4	56.0	.321	.403	.398	.86	.67	.90	N. N. E.	N. N. E.	S. by E.	152.90	3.0	0.104	....	Cu. Str. 8.	C. Cu. 4.	C. C. 8.
20	657	534	762	52.0	77.2	57.3	.334	.678	.410	.86	.73	.88	S. S. W.	S. W.	S. by W.	58.70	2.5	0.042	....	C. Cu. 4.	" 2.	C. C. Str. 10.
21	730	700	792	47.2	76.7	56.2	.280	.646	.398	.88	.71	.90	S. E.	W.	W.	115.60	3.0	Inapp.	....	Rain.	Cu. Str. 4.	C. Str. 4. Dist. Thunder.
22	891	898	876	52.2	71.9	56.7	.334	.403	.357	.86	.54	.78	W.	W. S. W.	W. S. W.	230.70	2.5	....	....	Clear.	C. C. 4.	" 2.
23	928	849	879	51.1	86.2	56.7	.258	.762	.342	.71	.62	.78	W. S. W.	S. S. W.	S. S. W.	88.30	2.0	....	....	"	Clear.	Clear.
24	812	884	806	47.2	69.2	60.3	.249	.529	.456	.77	.75	.88	N. E. by E.	W. S. W.	N. E. by E.	30.80	2.0	Inapp.	....	C. C. Str. 6.	Slight Shower.	Cu. Str. 10.
25	778	845	834	56.1	77.5	67.0	.391	.632	.438	.87	.67	.68	N. E. by E.	N. E. by E.	S. S. E.	24.80	1.5	....	....	Clear.	Cu. Str. 2.	Clear.
26	730	720	700	60.1	89.8	68.2	.374	.802	.510	.73	.57	.75	N. by E.	S. S. E.	S. E.	42.90	1.5	....	....	C. Cirr. 4.	C. Cu. 4.	C. C. 2. Dist. Light. & Th.
27	665	572	634	64.6	96.0	76.1	.427	.633	.652	.71	.38	.73	S. by W.	S. W.	S.	61.10	2.0	....	....	Clear.	Clear.	Cu. Str. 4.
28	667	654	667	66.0	96.1	77.6	.476	.626	.564	.75	.37	.61	W. S. W.	S. S. E.	S. E. by E.	20.80	1.0	....	....	C. C. Str. 6.	Cu. Str. 4.	" 2.
29	666	598	572	62.4	89.9	70.7	.370	.630	.462	.66	.45	.65	S. S. E.	E.	W.	56.80	2.0	....	....	Clear.	Cirr. 4.	" 10.
30	416	322	480	60.5	76.2	53.0	.456	.652	.348	.88	.73	.86	S. E.	S. E. by E.	W. S. W.	191.70	2.5	0.329	....	Cu. Str. 10.	C. C. 10.	" 4.
...	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....					....	....	....

REPORT FOR THE MONTH OF JULY, 1862.

Day of Month.	Barometer—corrected and reduced to 32° F. (English inches.)			Temperature of the Air.—F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.			Horizontal Movement in 24 hours. In miles.	OZONE. Mean amount of	RAIN. Amount of, in inches.	SNOW. Amount of, in inches.	WEATHER, CLOUDS, REMARKS, &c., &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.					6 a. m.	2. p. m.	10 p. m.
1	29.517	29.495	29.599	50.0	67.8	60.0	.309	.418	.365	.85	.62	.76	W. S. W.	W. S. W.	S. W.	193.10	2.0	....	....	Cu. Str. 4.	Clear.	Cu. Str. 4.
2	671	743	854	60.1	84.2	62.9	.374	.584	.429	.73	.50	.77	S. S. W.	S. W.	S. by E.	82.80	1.5	....	....	C. C. Str. 4.	"	C. Cirr. 4.
3	905	883	30.030	54.7	84.2	63.0	.282	.677	.429	.67	.60	.77	S. E.	S. S. W.	S. S. E.	25.40	1.0	....	....	Clear.	Cirr. 2.	C. Str. 4. Dt. T. & Lt. 8 p.m.
4	30.062	913	29.933	56.4	89.8	73.1	.308	.848	.624	.69	.61	.79	S. by W.	S. W.	S. by W.	197.10	1.0	....	....	"	Cu. Str. 4.	C. C. Str. 4.
5	29.853	814	762	70.0	93.5	74.2	.592	.887	.641	.83	.56	.77	W. S. W.	S. W.	S. W.	103.20	1.5	0.050	....	"	Rain. Dist. Thunder.	C. Str. 5.
6	642	588	623	70.6	94.0	73.0	.592	.840	.552	.83	.55	.70	W. S. W.	W. S. W.	S. S. W.	285.50	1.0	....	....	Hazy.	Hazy.	Hazy.
7	754	600	468	63.3	84.3	71.0	.416	.704	.476	.72	.60	.64	S.	W. S. W.	S. by W.	55.60	1.0	....	....	"	"	"
8	451	472	547	65.0	85.4	54.7	.576	.657	.276	.92	.55	.65	S. by W.	S. W.	S. W.	86.40	1.0	Inapp.	....	Slight Rain.	Clear.	C. C. Str. 8.
9	414	397	642	47.4	61.4	45.4	.249	.442	.245	.77	.83	.81	S. W.	S. S. W.	S. W.	114.40	2.5	0.206	....	Cu. Str. 10.	Rain.	Cu. Str. 4.
10	702	735	759	49.5	70.6	54.7	.273	.616	.315	.80	.57	.78	W. S. W.	W. by S.	W. by S.	103.80	1.5	....	....	Clear.	Clear.	Clear.
11	800	765	801	52.1	79.8	66.2	.257	.608	.433	.66	.60	.68	W. S. W.	W. S. W.	W. by S.	182.60	1.0	....	....	Hazy.	Hazy.	Hazy.
12	738	555	550	58.9	72.6	65.4	.358	.489	.451	.73	.62	[illegible]	W.	S. W.	S.	211.20	1.0	....	....	"	"	"
13	496	344	479	64.2	82.2	75.2	.464	.572	.897	.77	.52	.71	S. W.	W. S. W.	S. S. W.	149.50	2.0	0.300	....	Cu. Str. 10.	C. Cirr. 8.	Cu. Str. 4.
14	608	644	760	50.0	73.6	60.5	.240	.513	.403	.68	.67	.79	N. E. by E.	S. by E.	S. W.	86.10	1.0	....	....	" 6.	" 8.	Clear.
15	722	701	611	49.4	86.0	62.4	.272	.684	.517	.78	.56	.91	S. W.	S. S. W.	N. E. by E.	83.60	2.5	0.533	....	Clear Heavy dew.	" 4.	Nimb. 10.
16	666	604	742	60.1	79.2	60.2	.439	.612	.396	.88	.62	.76	S. by W.	S. E.	W.	235.40	2.0	....	....	"	" 8.	Clear. Distant Thun. & Lightning.
17	806	785	929	58.6	69.0	62.8	.365	.501	.413	.76	.72	.77	N. E. by E.	N. E. by E.	S. by W.	123.60	1.0	....	....	Cu. Str. 10.	Cirr. 4.	"
18	950	956	947	54.1	85.0	64.2	.315	.739	.433	.77	.62	.73	N. E. b, E.	S. by W.	S. by W.	23.10	1.5	....	....	Clear.	Clear.	Str. 2.
19	896	794	781	60.5	80.9	65.6	.367	.592	.444	.71	.57	.71	S. W.	S. W.	S. S. E.	35.50	1.0	....	....	C. Cirr. 4.	C. C. Str. 10.	Cirr. 2.
20	654	593	618	63.2	70.9	61.3	.510	.544	.413	.88	.73	.77	S. S. E.	S. by E.	S. by E.	154.40	2.0	0.100	....	Cu. Str. 10.	" 8.	Cu. Str. 2.
21	717	704	842	51.1	77.9	69.0	.296	.632	.564	.79	.67	.79	N. by E.	N. E. by E.	S. E.	59.65	1.0	....	....	Clear.	" 4.	Str. 2.
22	810	796	805	54.6	79.1	68.0	.301	.651	.453	.71	.66	.79	S. E.	S. S. W.	S. S. W.	107.80	1.0	....	....	"	" 9.	Cu. Str. 10.
23	703	503	424	54.1	58.0	56.0	.390	.459	.420	.93	.97	.94	S. S. W.	S. S. W.	S. S. W.	268.50	3.0	0.656	....	Nimb. 10.	Rain.	" 10.
24	556	566	614	64.1	83.6	63.0	.529	.702	.453	.89	.72	.94	S. W.	S. W.	S. by W.	201.50	2.5	0.094	....	C. Cirr 2.	Cirr. 4.	" 10.
25	636	604	632	30.0	77.9	62.4	.453	.632	.436	.85	.67	.80	S. S. W.	S. W.	S. W.	120.10	2.0	....	....	Rain.	Clear.	Str. 2.
26	694	679	762	68.4	81.7	60.9	.453	.451	.449	.80	.73	.85	S. S. W.	S. W.	S. W.	106.40	1.5	Inapp.	....	C. C. Str. 2.	Cirr. Str. 4.	Cu. Str. 4. Distant Thunder.
27	754	716	796	68.1	80.9	64.2	.485	.592	.529	.78	.57	.89	W. S. W.	W. S. W.	W. S. W.	199.00	2.0	0.400	....	Clear Heavy dew.	Clear.	" 10.
28	764	735	781	64.1	77.3	62.1	.464	.639	.491	.77	.69	.88	S. W.	S. W.	S. by E.	84.60	2.0	0.271	....	Cu. Str. 6.	Cu. Str. 10.	" 10.
29	793	652	793	64.0	78.9	57.2	.569	.863	.436	.97	.89	.94	S. by W.	S. S. W.	S. W.	25.60	2.0	1.157	....	Rain.	C. C. Str. 9.	C. Str. 10. Shower. Dist. Thu.
30	696	741	895	61.4	81.6	69.9	.449	.617	.592	.85	.58	.83	S. W.	S. W.	S. by W.	39.50	2.5	....	....	C. C. Str. 10.	" 9.	Clear.
31	885	874	907	64.6	90.1	70.1	.490	.834	.523	.81	.58	.72	N. N. W.	S. E.	S. S. W.	8.80	1.5	....	....	Clear.	Cum. 3.	"

REMARKS FOR JUNE, 1862.

Barometer....... Highest, the 16th day, 30·114 inches.
Lowest, the 30th day 29.322 "
Monthly Mean, 29.713 "
Monthly Range, 0.792 "

Thermometer... Highest, the 28th day, 96°1.
Lowest, the 16th day,—36°2.
Monthly Mean, 64°61.
Monthly Range, 59°9.

Greatest intensity of the Sun's rays, 101°2.
Lowest point of Terrestrial radiation,—33°1.
Mean of Humidity, .660.

Amount of Evaporation, 4.16 inches.
Rain fell on 8 days amounting to 1.132 inches it was raining 18 hours 15 minutes and was accompanied by thunder on 3 days.
Most prevalent wind, S. W.
Least prevalent wind, the E.
Most windy day the 22nd day, mean miles per hour, 9.62.
Least windy day the 2nd day, mean miles per hour, Calm.
The Eclipse of the Moon was visible.
The Electrical state of the Atmosphere has indicated High Intensity.
Fire flies (*Lampyris Corusca*) 1st seen 11th day.

REMARKS FOR JULY, 1862.

Barometer....... Highest, the 4th day, 30.062 inches.
Lowest, the 9th day, 29.397 "
Monthly Mean, 29.731 "
Monthly Range, 0.665 "

Thermometer. Highest, the 6th day, 94°0.
Lowest, the 14th day, 40°0.
Monthly Mean, 65°33.
Monthly Range, 54°0.

Greatest intensity of the Sun's rays, 102°1.
Lowest point of Terrestrial radiation,—37°4.
Mean of humidity, ·787.

Amount of Evaporation, 3.01 inches.
Rain fell on 12 days, amounting to 3.767 inches; it was raining 35 hours and 6 minutes and was accompanied by thunder on 5 days.
Most prevalent wind, S. W.
Least prevalent wind, S.
Most windy day, the 6th day; mean miles per hour, 11.81.
Least windy day, the 31st day. 0.37.
The Electrical state of the Atmosphere has indicated moderate intensity.

CONTENTS OF NUMBER IV.

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The next number of this Magazine will be published in October, 1862.