THE

CANADIAN

Naturalist and Geologist.

BY E. BILLINGS.

VOLUME I.

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INDEX TO VOL. I.

THE

CANADIAN NATURALIST AND GEOLOGIST.

THE above named Magazine will be devoted to the Natural History and Geology of Canada and the neighbouring British Provinces. It will contain—

1. Articles upon the Geological Phenomena, rocks, minerals and fossils of those countries, illustrated by suitable wood or stone engravings.
2. Ditto, upon the Natural History of the indigenous Quadrupeds, Birds, Reptiles, Fish and Mollusca,—comprising their description, habits, instincts, and geographical distribution.
3. A record of discoveries in the sciences of Geology and Natural History.

It will be issued in numbers, six times in the year, in the months of February, April, June, August, October and December, each number containing from twenty to thirty wood cuts, and one or more lithographic, steel, or copper plates, according to circumstances. These will consist of original drawings from Canadian specimens, or copies from the best published authorities. The six numbers of each year will form a book of 480 pages, with over 120 engravings and a glossarial index, which will accompany the last number of the year. Like most other periodicals, its contents will be in part compiled and in part original matter. The former will be selected from the best English, French and German works, and the latter will be founded upon materials collected in Canada by the subscriber. In this part there will be found descriptions and figures of many remarkable species of extinct animals.

As the work is intended to be useful to young persons, all of whom ought to be well versed in the Geology and Natural History of their native country, the technical terms used will be explained or translated in cases where it may be necessary.

TERMS :—15s. per annum, payable in advance.

All communications to be addressed (post paid) to the subscriber.

E. BILLINGS.

Ottawa, 15th February, 1856.

(From the Ottawa Citizen, 16th February.)

In another column will be found an advertisement of a Magazine of NATURAL HISTORY, about to be commenced in this city, under the above title. The subjects to the investigation of which it will be devoted are the Zoology and Geology of the British Provinces of North America. These very interesting departments of knowledge are, of late, being sedulously cultivated in all civilized countries, and it is, therefore, thought not out of place to attempt something of the kind in Canada. We do not wish to be understood as intimating that no efforts have been made in this direction in this Province. On the contrary, at Quebec and Montreal there have been long in existence two Natural History Societies, and at Toronto, the Canadian Institute, established partly for the same purpose, is also in a flourishing condition. Again, in several of the Universities of the Province, chairs of Natural History and Geology have been endowed, and which are now filled by some of the ablest scientific men of the age. One thing more, however, is required, and that is a periodical literature, devoted exclusively to the study of Natural History, circulating everywhere throughout the country, and published at a price within the means of the greater proportion of readers. It is not necessary in this age of the world, to urge that these sciences are useful. All knowledge is good, and all will admit that the lessons we receive from the contemplation of nature and her wondrous laws, whether as exhibited in the growth of a plant, the instinct of a beast in pursuit of its prey, the gentle affection of a bird for its young, or the more grand operation of the revolution of a world, are those the most instructive and the most illustrative of the wisdom, power and goodness of Providence. All science is founded upon the understanding of those laws. All the power that man has acquired over the material world has been derived from the observation of their modes of operation. The more men observe, the more they must learn, and it is undoubtedly the opinion of all the best educationists, that no intellectual pursuit is better adapted to strengthen the observing powers than that of Natural History. The habit of noticing objects, of comparing them with each other, ascertaining their relations and usefulness, is one that should be cultivated to the utmost in the young, as it is upon this mental acquisition that the future success in life of the individual must, in a great measure, depend; and as the two sciences to which the magazine proposed to be established will be devoted, consist altogether of such exercises, it will, no doubt, be useful to the youth of the Province. Every young man should know something about the Geology and Natural History of his native country. He should endeavour, in his leisure moments, to make this a large share of his general stock of knowledge, and he will find that in after life thousands of occasions will arise, when he will not regret that he acquired such information. The resources of a young country cannot be speedily developed without the intelligent application of the principles of these branches, and we think it a wise resolution of the Legislature to encourage, by liberal grants, the different institutions devoted to these subjects. There are certain great problems connected with the laws of animal life, the investigation of which is of the very highest national importance. The dreadful ravages of certain species of insects upon the vegetable food of man have frequently plunged nations into the horrors of famine. How to guard against such visitations cannot be known until we shall have attained to a more profound knowledge of Natural History than that possessed by the most learned men of the world. So little progress has been made towards the solution of this great question that we are at this moment no farther advanced in it, than was the human race 6,000 years ago. Of this much only are we certain: the road to it lies through Natural History. The more widely this science is diffused, the greater the host of observers, the nearer we shall be to the desired end. Man has nearly all his friends and foes in the animal, vegetable and mineral kingdoms. Some furnish him with shelter, others with clothing, food, or cures for his ailments; while still others destroy continually his subsistence, rob him of his labours, or with their poisons slay him. It is useful knowledge to recognize our friends from our foes, and such is simply the knowledge of Natural History. For these, and a host of similar reasons that might be stated, we conceive that the objects of the proposed new journal are at least good. There is no part of the world in the same latitude more rich in Natural History objects than Canada; but from a pretty extensive examination of the subject we are satisfied that these have not been as fully explored and laid open to the reading world as their importance demands. It would be difficult to point out more than thirty published papers of any value in the scientific journals upon this subject, so far as it relates to Canada; and these are most of them not easily procured by the general reader. In the Canadian Naturalist and Geologist an attempt will be made not only to collect, review and compile all the information hitherto published concerning the material productions of these Provinces, but also to give an account of many new discoveries not yet placed before the scientific world.

Every exertion, we are assured, will be made to insure accuracy, and it is therefore hoped that the work will be found useful to all who desire to make themselves acquainted with the Natural History of this part of the continent.

In addition to the observations contained in the above paragraph, it may not be out of place for me to remark that those who have laboured so successfully in order to gain for this young and flourishing colony, the high reputation it bears abroad for the abundance and excellence of its economical resources, would, no doubt, rejoice could it also become as favourably known for the devotion of its people to the cultivation of science. This name cannot be well gained unless we make contributions of new truths to the stock of human knowledge already acquired. It is not enough that we diligently study the sciences perfected by the labours of others, but we should endeavour to add something—the fruit of our own researches. Otherwise, it cannot be said that we have accomplished anything towards the advancement of learning, but only contented ourselves with following in the wake of those more industrious. There is not a square mile of the whole surface of this Province which does not contain a greater or less number of scientific truths yet remaining to be developed, any one of which, if properly brought to light, would be highly prized by the "savans" of Europe. There is not a Township in which a noble museum of Natural History could not be collected. If there were in each county a few young men sufficiently advanced to classify the specimens of their immediate neighbourhoods, such collections would soon make their appearance; but without much preparatory instruction, this very desirable state of things cannot be expected. I have learned by some personal experience that the knowledge necessary to enable a person to examine for himself, cannot be procured in this country without great difficulty. The reason is, that the books in general circulation contain little or no information concerning the species of fossils, animals or plants, peculiar to, or which range into this Province. The greater number have been described by the scientific men of other countries, but then these descriptions are scattered through the Journals of the different learned Societies of Europe and America, or published in books not easily procured. Without the assistance of such information, practical observers must be rare in this country—with it, they would abound in every county in the Province. There is no lack of ability in the youth of Canada, but they are sadly destitute of books which might enable them to make practical application of their talents in the study of any one of the innumerable objects of nature with which they are everywhere and at all times surrounded. Men do not take much interest in things they cannot investigate, and hence that universal indifference, of which the several literary societies of Canada so frequently complain.

The Magazine proposed to be established will be devoted exclusively to the Geology and Zoology of the British Provinces of North America, and in conducting it, I shall endeavour to make it as useful as possible to all who may feel interested in the subjects to which it will be confined. I shall collect and compile all the information concerning the fossils and animals of the country within my reach, commencing with the larger quadrupeds and more characteristic and common organic remains, and thence gradually proceeding to those more rare or hitherto undescribed. The works consulted will be the best European and American authorities. In the present number, some of the matter in two of the articles, as will be observed, has been taken from the Reports of the Geological Survey of Canada; but as I understand that these invaluable documents are about to be re-published for general circulation, I shall confine myself with this exception to other sources, and such discoveries as I have made myself. In fact, this journal will consist more of Natural History than of Geology in the restricted acceptation of that term. It is intended principally to be of assistance to the youth of Canada, but as it will also contain many new species, and even several new and very remarkable genera of extinct animals, I hope that scientific men will also regard it as favourably as they can. In conclusion, I would respectfully solicit the public men of the Province, and others who can do so without inconvenience to themselves, if they think the work worthy of encouragement, to aid it by subscribing for it, and also by using their influence in its favour

E. BILLINGS.

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VOLUME I. FEBRUARY, 1856. NUMBER I.

ARTICLE I. Introductory.—*Elevation and subsidence of Land—Various Theories of the Earth—Origin of Stratified Rocks—European and American Formations—Geographical Distribution of the latter in Canada.*

The Natural History of any extensive region comprises the description, not only of the existing races of animals, but also of those which have become extinct in former ages, and whose remains are found in a fossil state within its limits. The latter part of the subject is again intimately connected with the physical or geological structure of the country, owing to the fact that in all parts of the world large tracts of the earth's crust consist of formations of rock, often of great thickness, composed some of them almost entirely of such organic remains, while further, the order in which they may be arranged has an important bearing upon the public wealth and national strength of the people occupying the particular territory under consideration.

In this journal an endeavor will be made to explore every source, whence information upon the Natural History of Canada and the neighbouring British Provinces may be derived, and under the circumstances it is thought advisable to commence with a short examination of some of the leading features presented by the science of Geology, It is scarcely necessary to observe, that a large proportion of the matter must be compiled from the works of various authors, and consequently, many readers will discover in the following pages, much which they have met with elsewhere, But in addition to what is already known, there will also be found in some of the other articles many things not heretofore published. The latter cannot be well interpreted, without the assistance of the former. It generally requires all the old knowledge to explain new discoveries, and therefore for the convenience of the larger class of readers, we must trespass somewhat upon the patience of the lesser number.

To understand clearly, the nature of those causes that have produced at various times, the great beds of rock, which constitute the exterior layers of the earth's crust, is not difficult, provided the attempt be made in the right direction; and yet this knowledge remained undiscovered by man, until near the commencement of the present century. Strange as it may appear, the clue to the history of vast mountains and even whole continents of stone, was not found where it would be naturally sought for, in the mineral portion of our planet, but where it could be least suspected of lying concealed, in the study of the animal kingdom. Geologists have succeeded in discovering and explaining the structure of the globe, for a distance of several miles beneath the surface; but these triumphs of science were only accomplished, through the assistance afforded by the organic remains, imbedded in the different formations. The study of these relics of ancient life, is therefore not only of great interest, but also of an importance nearly equal to all the advantages that countries rich in mineral treasures may derive from such resources.

In the earlier ages of the existence of the human race, it had become known that in certain regions, sea-shells, bones of fishes and other remains of marine animals, were to be found upon the dry land, in places far from the shore, upon the summits of lofty hills, or deeply buried in the solid rock, and facts of so extraordinary a character, could not but have given birth to a vast deal of discussion. The history of geology, should properly commence at that moment when the first inquiring person began to wonder by what process these exuviae of the sea came to occupy positions apparently so anomalous. What those speculations may have been, we can never know; —the thought permitted to pass away unrecorded, must be lost forever. Doubtless many theories were conceived, but they have not, and perhaps it is not important that they should have been preserved.

Among the ancient Grecians, the idea of the elevation and subsidence of land, or that it sometimes sinks down and after lying for a time, beneath the waves rises again, [illegible] up with it, the deposit of marine remains accumulated upon [illegible] appears to have been much favored by their [illegible] Aristotle in one of his works, says "the distribution of [illegible] particular regions, does not endure throughout all time, but [illegible] those parts where it was land, and again it becomes land [illegible] and there is reason for thinking that these changes take place according to a certain system, and within a certain period; [illegible] neither the [illegible] nor the Nile, can have flowed forever. The places where they [illegible] dry, and there is a limit to their operations: [illegible] So also of all other rivers; they spring up and they [illegible] also continually deserts and invades others.—

The same tracts therefore of the earth are not, some always sea, and others always Continents, but everything changes in the course of time." Strabo also, was of the same opinion, and says—" it is not merely the small, but the large islands also, and not merely the islands, but the continents which can be lifted up together with the sea; and both large and small tracts may subside, for habitations and cities, like Bure, Bizona, and many others, have been engulphed by earthquakes."*

This theory of the elevation and subsidence of land, affords at a glance a sufficient explanation of the occurrence of sea-shells in the interior of continents, or even on the tops of the mountains; but although it readily suggested itself to the Greeks, who were in general, a very intellectual race of men, it did not obtain full credence for many ages after the time of the eminent philosophers, whose opinions we have quoted. Within a recent period, it has received ample confirmation from actual observations of scientific men, who have carefully watched its progress in several parts of the world, where the process of rising and sinking can be seen in actual operation.

It is about 150 years, since Celsius a Swedish Naturalist, gave it as his opinion that the levels of the Baltic and Northern Ocean were subsiding, and since his day the shores of those seas have been frequently examined with great care in order to ascertain whether the phenomenon really existed. In 1807, the celebrated geologist, Leopold Von Buch, visited the country, and after a most patient exploration, confirmed the views of Celsius. Grooves had been made in the rocks, marking the level of the Baltic, by some engineers of that country, many years before, and it was thus an easy matter to keep an account of the progress of the elevation. These grooves have been examined by Sir Charles Lyell, and Sir Roderick Murchison and the fact established, that the northern part of the country is rising at the rate of four feet in a century.

On the coast of Puzzuoli near Naples, there was erected about a century before the Christian Era, a temple to some one of the Gods, worshipped by the Romans. It was constructed with a Mosaic pavement, from which arose forty-six noble columns, forty feet high, and formed each of a single block of stone. The pavement at the time of its construction, was twelve feet above high-water mark, but the country soon began to sink, and towards the close of the first century after the birth of Our Saviour, the foundation was but six feet above the tide. At the end of the fourth century, it was on a level with the sea—in the middle ages, it was twenty-one feet below the surface and all the pillars except three were thrown down by the waves. It then began to rise and in the beginning of the present century, the pavement was one foot above high-water mark, but it is going down again, for it is now one foot below the surface of the water. There is an abundance of evidence in other places along this coast, the west coast of Italy, to show that the country is subject to such oscillations, of level, but at the temple of Serapis, the facts may be regarded as of the greatest interest, for there they have been made the subject of actual observation.

* See Lyells Principles of Geology, 8th Edition, page 15.

It has lately been ascertained, that one end of the Island of Newfoundland is rising while the other is sinking. In the eastern tropics, Ceylon and all the islands east of it, such as Sumatra, Borneo, the Phillipine Islands and others, are rising—the Maldiva Isles are sinking down, and the eastern coast of Africa with Madagascar are rising, but Australia is going down with her fields of Gold, and in course of time will wholly disappear.

With such facts in our possession we are forced to admit that elevation and subsidence of land as conjectured by Aristotle and Strabo, are no longer to be regarded as mere fanciful suppositions, but part of the actual and ordinary operations of Nature, and we have only to extend it over large continents, such as America or Asia, to understand how sea-shells may be found, in places far inland, or upon the highest table lands. Thus, if North America should sink 500 feet, nearly all Canada would be submerged. The waves of the Atlantic would then beat against the Queenston Heights, near the Niagara Falls. The precipice beneath Brock's Monument, and the high land which runs thence in the direction of Hamilton, would form a sea coast of no very great elevation. A subsidence of 1000 feet would only leave a few small rocky islands, to mark the place of this Province, while at the depth of 2000 feet nearly all that portion of North America at present inhabited would disappear. Were it to remain thus submerged for several centuries, and then slowly rise up and become dry land, we should expect to find it covered with all kinds of those oceanic products, the occurrence of which upon land, so long remained an unexplained phenomenon to the greater portion of mankind.

We have abundant proof that Canada was entirely covered by the ocean, at a time comparatively recent. At Beauport near Quebec, there are situated between 100 and 300 feet above the level of the sea, great banks of sea shells of the same species as those now living in the ocean. Throughout the level country, on both sides of the St. Lawrence above Quebec, the same shells are found in many places in greater or less abundance. They may be seen in the deep cutting of the Railway, at Prescott, and have been ploughed up on the farms in almost every township between the St. Lawrence and the Ottawa rivers. In the Township of Gloucester many perfect skeletons of the "Capelan" and "Lump-sucker" fish, now existing in the Atlantic, together with numerous shells have been found imbedded in small nodules of indurated clay. Near the top of the mountain of Montreal, there is a bed of the same shells. In Vermont, near the Province Line, in the same deposit, the skeleton of a small whale was discovered a few years since, and everywhere the water-worn pebbles, beds of stratified sand, and other evidences of the sea may be detected upon the slightest observation. This deposit of sea-shells, sand, gravel and boulders which covers Canada, and constitutes the loose soil of the country, can be shown to have drifted down from the north, and is therefore called by Geologists, the northern or glacial drift. In a future number, we shall give it a more extended examination. It proves that Canada does not rest upon a very secure foundation, but may at any time as it has in days past, go down bodily beneath the waves of the sea.

The organic remains of this deposit, are all, perhaps with one exception, of existing species, but if we remove the drift or loose materials, such as the clay, sand and gravel, down to the floor of solid rock, which lies beneath, we should find in many places, this rock also full of petrified sea-shells, and fragments of other marine animals. But these are all of extinct species.—They belong to an ocean of a date vastly more ancient, than that of the glacial drift, and afford proof of more than one submergence of the country.

It is thus all over the world. The researches of Capt. Strachy, a scientific British Officer, in the East Indies, show that for the greater part the Himalaya Mountains, are little else than a vast pile of marine remains, and so it is with the Alps, the Andes, and most of the other ranges of great hills found upon the surface of the earth. There is no such condition as stability in nature. All things are in a state of unceasing change, either in their form or place, and although during the few years allotted to a human being for his existence, little alteration can be perceived, yet during the progress of ages, those changes become upon the whole so great, that they transform the exterior of the world, bringing the seas to occupy the places of former continents, and the continents of one age to constitute the bottom of the seas of another.

Concerning the nature of those forces which produce elevation and subsidence of land, we have no knowledge beyond mere conjecture. Some Geologists suppose that in consequence of certain chemical operations in the interior of the earth, great quantities of gas are generated which cause the surface to swell up and by the condensation of this vapour, or its escape through volcanoes, suffers it to subside at other times. Another theory is in substance, that the interior heat of the planet frequently changes its place. Thus a great accession of heat in the strata of rock beneath the bottom of the Atlantic, might so expand those rocks as to raise them above the surface of the ocean, and in the same way the withdrawal of the heat to some other region, might suffer the newly created continent to sink down again. It is also supposed that the changes in the relative distribution of land and water, may be the effect of the earth's contraction. The philosophers who advocate this latter theory, think that the earth was originally in a fluid state, from intense heat—that it has cooled down to its present temperature, and that during this refrigeration, its dimensions have become less. They urge, that while contracting, its surface would be variously folded into ridges of mountains, depressions and elevations which would not always occupy the same place. Hence, a tract at one time forced upwards by lateral pressure, would at another time be let down by the transfer of the force to a different point. Either of those causes might produce some of the effects ascribed to them: but as yet, we have no proof that a single earthquake, volcano, elevation or subsidence has thus been occasioned. The forces to which these phenomena owe their origin, appear to be exerted far beneath the surface, and will probably never be observed by man.

Geology is a science of a recent date, and in order to exhibit the state of opinion in Europe, within the last two hundred years, upon the subjects it investigates, we shall here give a short digest of some of the principal theories that have been put forth during that period. These are to a certain extent connected with the matters we have been considering, and as they were the ideas of the most learned men of the age, they show what progress had been made in this department of knowledge up to that time.

According to Burnet's Sacred Theory of the earth, written in 1690, the globe was at first a chaos of fluid, composed of different substances, which differed also from each other, in their specific gravity. The most weighty sank to the centre, and there solidified, while others floated upon the surface and formed a crust of rich, light soil. The exterior of the planet became one continuous level plain, with an equable mild climate, and clothed with a luxuriant vegetation. It was a paradise, into which man was introduced to enjoy all the delights of existence, without the cares that vex his life in modern times. On account of the sins of mankind, the Deity suffered the rays of the sun, to dry up the thin surface, so that it cracked open and fell in; destroying the human race, and all living things by one great convulsion. Eight persons only, were saved; and fragments of the original crust of the earth afterwards rising, above the surface of the waters, to form the present islands, and continents, the few individuals preserved, settled themselves upon these and thus repeopled the globe.

Woodward's theory, published in 1695, intended to account for the occurrence of marine remains, in the depths of the earth, and was founded upon the idea, that at the time of the flood, the world was dissolved into one universal fluid, in which, however, the sea-shells and bones retained their solidity, floating freely throughout the general mass. On the restoration of the earth, the heavier substances first sank to the centre, where they formed a nucleus, around which the others arranged themselves in successive layers, like the coats of an onion. In this way the stratification of rocks, and the regularity in which the various formations repose upon each other, was explained.

Whiston's theory, was much more complicated. He supposes the earth to have been originally a comet, subjected to the most intense heat, on its near approach to the sun; and to extreme cold, while passing through those distant regions of space, penetrated by such bodies, while traversing over the more remote portions of their orbits. It was thus alternately melted and frozen, over and over again, until its materials became thoroughly mixed together, forming a chaos, far from being solid. He compares it to a dense, though fluid atmosphere, composed of substances mingled, agitated, and shocked against each other; and in this disorder, he describes the earth to have been just at the eve of creation. Its orbit was then changed, and it became a planet, revolving in a circle so that it remained at all times, at about the same distance from the sun. At the time of its conversion from a comet into a planet, it also became in part solid, there remaining a nucleus of melted matter in the centre, surrounded by the solid crust, which latter as in Woodward's theory, was formed of concentric layers, while the ocean being the lightest, floated upon the exterior. The tails of Comets, he supposed to be formed of a watery vapor. One of these struck the earth and occasioned the deluge. The planet became entangled in the trail of the comet, and by its attraction, drew around itself a shroud of water, which covered the tops of the highest mountains, and involved all living things in an universal catastrophe. The punishment of the wicked being completed, the earth became enlarged, yawned open and receieved the waters into its interior, and man was again restored. "In the universal wreck," says Goldsmith, "Noah survived by a variety of happy causes, to re-people the earth, and to give birth to a race of men, slow in believing, ill-imagined theories of the earth."

Concerning the theories of Burnet, Woodward and Whiston, all that need be said is that they had not one fact in nature to support them. They were purely the creations of the imagination. And yet they are not without interest to the Geologist, who, in these we may recognize the first unsuccessful efforts of the human mind, to make out the great truths afterward acquired. The child must often fall, before it can walk with the well balanced step of manhoood, and the theoretical failures of the world-makers of the past, are but the first struggles of the infant intellect of our race, to attain that perfection which the Almighty has willed can only be secured as the fruit of labour.

Next came speculations of Buffon, who, being well acquainted with natural history, was better prepared to deal with a subject, which can only be understood by consulting nature herself. He supposed that the matter of all the planets, at one time constituted a portion of the sun—that a comet struck that luminary and so shook its whole frame, that some of its particles were driven off like streaming sparkles from red hot iron and that each of those jets of melted matter, formed itself into a planet. Our earth was thus derived from the sun. Having been launched far out into the colder regions of space, it cooled down, solidified upon its surface and became a habitable globe.

Thus far Buffon drew upon his imagination, but when he speaks of the origin of stratified rocks and the occurrence of marine shells upon dry land, his observations are more worthy of consideration. "The surface of the earth, says he," must have been in the beginning much less solid than it is at present, and, consequently the same causes which at this day produce but very slight changes, must then upon so complying a substance, have had very considerable effects. We have no reason to doubt that it was then covered with the waters of the sea, and that those waters were above the tops of the highest mountains; since, even in such elevated situations, we find shells and other marine productions in very great abundance. It appears also that the sea continued for a considerable time upon the face of the earth, for as these layers of shells are found so very frequent at such great depths, and in such prodigious quantities, it seems impossible for such numbers to have been supported all alive at one time, so that they must have been brought there by successive depositions. These shells also are found in the bodies of the hardest rocks where they could not have been deposited all at once at the time of the deluge, or at any such instant revolution, since that would be to suppose that all the rocks in which they are found were at that instant in a state of dissolution, which would be absurd to assert. The sea, therefore, deposited them wheresoever they are now to be found, and that by slow and successive degrees. It appears also that the sea covered the whole earth from the appearance of its layers, which lying regularly one above the other, seem all to resemble the sediment formed at different times by the ocean. Hence by the irregular force of its waves, and its currents driving the bottom into sand banks, mountains must have been gradually formed within this universal covering of waters; *and these successively raising their heads above its surface*, must in time, have formed the highest ridges of mountains upon land, together with continents, islands, and low grounds, all in their turns. This opinion will receive additional weight, by considering that in those parts of the earth where the power of the ocean is greatest, the inequalities on the surface of the earth are highest. The ocean's power is greatest at the equator, where its winds and tides are most constant, and, in fact, the mountains at the equator are found to be higher than in any other part of the world. *The sea, therefore, has produced the principal changes in our earth*, rivers, volcanoes, earthquakes, storms, and rain, having made but slight alterations, and only such as have affected the globe to very inconsiderable depths."

If Buffon had been living during the beginning of the present century, no doubt he would have become a very able geologist. His idea, that the sea produces the principal changes on the surface of the earth, lies at the foundation of the science of geology; but he attached too little importance to the operations of the other phenomenon of nature, such as storms, rain, rivers, earthquakes, and volcanoes. It is by the combined efforts of these working together through a long series of ages, that the whole surface of the earth has been remodelled over and over again.

If we consider what must be taking place upon the floor of the ocean at present, and suppose the same operations to continue for a few thousand years hereafter, it may perhaps serve to give us a clearer idea of the origin of the great beds of stratified rocks with their animal contents which at present furnish so much material for interesting research.

The sea may be regarded as the grave of the land,—the continents are yearly, daily, and hourly being swallowed up by the ocean—every wave that beats upon the shore carries back with it some portion of the soil which after floating about for a while sinks into the depths. Every river is continually pouring out into the sea a cloud of dust, held in solution in its waters, but gathered from the interior of the continent; it deposits this dust upon the bottom in wide spread out layers, whence it returns to land no more; although the sediment remains where the currents leave it, yet the water by which it was transported has no rest; it is taken up into the clouds by evaporation, it is blown inland by the winds, it falls upon the plains or mountains, collects into brooks, forms mighty rivers and again journeys down to the ocean freighted with another cargo of sediment; year after year it labours on, silently but unceasingly, "water weareth the stone," and we have only to grant sufficient time to the rivers and the waves to perform their works, and they will most certainly carry away every vestige of the land that now rises above the level of the tide.

The bottom of the ocean is thus constantly receiving new layers of sediment consisting of the pasty ruins of all countries, commingled with the shells of mollusca—the bones of vertebrated animals—the remains of man—works of art—whole cargoes of merchandize—wrecks of ships, and every other thing, whether organic or inorganic, that can be named. One of Shakespeare's characters dreamed that he was drowned, and while beneath the waters he—

Saw a thousand fearful wrecks;
A thousand men that fishes gnawed upon,
Wedges of gold, great anchors, heaps of pearl—
Inestimable stones, unvalued jewels
All scattered in the bottom of the sea,
Some lay in dead men's skulls, and in those holes
Where eyes did once inhabit, there were crept
(As 'twere in scorn of eyes,) reflecting gems
That woo'd the slimy bottom of the deep,
And mocked the dead bones that lay scattered by.*

The rate at which the bottom of the ocean gains in thickness is not known, perhaps one foot upon an average in a hundred years would be a large allowance. In certain localities, such as near the mouths of great rivers, the growth may be much more rapid, in other regions less; but everywhere there is a gradual increase, so that the deposit of to-day, with its imbedded shells, bones, and wrecks, will, in a thousand years, no longer lie upon the bottom but be buried many feet beneath.

By the ordinary operations of nature, then, such as the wasting away of the land and the spreading out of its ruins over the bottom by the currents, the cavity of the ocean must be filling up, and in five millions of years hence at the rate of one foot in a century the most profound depths of the Atlantic will be full; the thickness of the deposit would be between eight and nine miles. The bones of the poor sailor that sink during the present year would then have miles of stratified rocks heaped upon them. What changes may take place in the world in five millions of years, we know not, but this much is certain, that should all the present races of animated things become extinct within the next few centuries, at the end of the vast period we have supposed, their remains must, at least some of them, lie far down in the earths crust.

Now what we have conjectured as possible for the future, geology proves to have actually taken place during the past. In all countries we find the cavities of ancient oceans, long since filled to the brim by successive layers of sediment, which, owing to the action of some petrifying cause, has been converted into stone and constitutes the stratified rocks. In Wales, the Government Officers employed upon the Geological Survey, have ascertained that the depth of one of those ancient hollows was nearly ten miles—it is now full. In North America another prodigious sheet of marine accummulations covers, almost without a break, one fourth of the continent. This great bed extends into Canada in two places, its thickness near its

* Richard III., Scene 4th.

centre in Pensylvania is almost four and a half miles, and it has been heaved up not only so as to constitute extensive countries of dry land, but even the long ranges of the Alleghany Mountains which extend from the Southern States north easterly through Lower Canada to the mouth of the St. Lawrence.

The grandest discovery made during the examination of these old deposits, is, that the world has changed its inhabitants several times since animated beings were first placed upon it by the Creator. Certain beds lying at the bottom contain the remains of particular species, few in number at first, but sufficiently well preserved to enable the Geologist to make out their form and structure. Higher up, there are other beds of rocks containing other species, but none of those that are found below. The sediment which constitutes these different formations was deposited in the seas of different ages, and the contained organic remains prove that the denizens of the oceans of the first age were no longer in existence when the ocean of the second period covered the earth. In the same manner a third deposit lies upon the second, with its fossils different from both of those below—above the third there is a fourth, and over this many more until we arrive at the surface.

As the deepest coal pits excavated by man do not penetrate to the depth of half a mile, it would be almost impossible to ascertain these facts were it not that the subterranean forces which cause the elevation and subsidence of land come in to the aid of the student of nature. Whatever may be the reason, certain tracts of country are more violently acted upon than others, and the earth is in such places so broken up that the sedimentary rocks instead of lying in a horizontal position as originally deposited, are tilted up and their edges clearly exposed upon the surface, where the Geologist may measure their thickness and study the organic remains contained in each formation at his leisure. It is beyond a doubt that rocks are now exposed in the full light of day which were once several miles beneath it.

As the whole of the series of sedimentary rocks is estimated at the thickness of ten miles; there can be no doubt but that a prodigious period of time has rolled away since the first strata were deposited on the bottoms of the primeval oceans. There is evidence in many of the beds that the materials of which they are formed were very slowly accumulated; some of them consist almost entirely of shells which lived and died upon the spot where they are now found. Often these shells are overgrown with coral in such a manner as to render it quite clear that after their death it was long before they were covered by the sediment. Other facts demonstrate that the process of accumulating matter upon the bottom proceeded with no greater rapidity in olden times than it does at present; to form ten miles of stratified rocks must have required a vast period of time, but how great, geology does not venture to say. All that this science can prove, with respect to time, is that certain rocks were formed after or before certain others, and this is shewn either by the superposition or the fossil contents of the strata. From the accounts above given of the origin of sedimentary strata, the non-geological reader will readily understand that the lowest are the oldest, and that as each formation contains fossils peculiar to itself and which occur in none of the others, once these fossils are known they serve as marks to identify the rocks of the different ages of the world.

These all important facts that in every part of the world the formations are disposed in a regular series, never reversed except in very few instances of small geographical extent, were only brought to light within the last seventy-five years. In 1778, Werner, a celebrated professor in the mining schools in Saxony, taught his scholars that, in the crust of the earth, beds of rocks were arranged according to a certain order, which he maintained prevailed throughout the whole world. About the same time, Mr. William Smith, an English Surveyor, by extensive examinations of the rocks of his native country, came to the same conclusions arrived at by Werner, and independantly of the German geologist; but Smith also announced, that the different formations were marked by particular fossils, peculiar to each, and this discovery really constitutes the key to the whole science of geology.

In 1790, Smith published his "Tabular View of the British Strata," and from this time forth, he laboured, says Sir Charles Lyell, "to construct a geological map of the whole of England, and, with the greatest disinterestedness of mind, communicated the results of his investigations to all who desired information, giving such publicity to his original views as to enable his contemporaries almost to compete with him in the race. The execution of his map was completed in 1815, and remains a lasting monument of original talent and extraordinary perseverance, for he had explored the whole country on foot without the guidance of previous observers or the aid of fellow labourers, and had succeeded in throwing into natural divisions the whole complicated series of British rocks. D'Aubisson, a distinguished pupil of Werner, paid a just tribute of praise to this remarkable performance, observing that "what many celebrated mineralogists had only accomplished for a small part of Germany in the course of half a century, had been effected by a single individual for the whole of England."*

After the publication of Smith's works a host of talented men entered the field of Geology, and the science at once, from a mass of crude undigested materials, fanciful theories and conjectural particulars, sprang up into a vigorous and well organized existence, comprising almost every branch of knowledge; the superbly interesting nature of its details soon attracted an eager crowd of the best labourers from every other department of learning, and in the short period of fifty years it has become what it is now, almost unequalled, either for the profusion and excellence of the literature it has called forth, or for the grandeur of the terrestrial history it has rescued from oblivion.

Having now glanced at some of the more important features of the history of Geology, let us next proceed to examine the order in which the various formations, with their included organic remains, are laid upon each

* Lyell's Principles of Geology, 8th ed., page 60.

other. A "*formation*" consists of any group of rocks which can be distinguished from all other groups by some particular mark. The thickness of these groups varies from a few feet up to several thousand. Thus the Potsdam sandstone, hereafter to be mentioned, has a depth of only about 250 feet, while the Hudson River group is at least 1,000. The formations are deposited one above the other in regular sheets in the order in which they were accumulated upon the bottom of the sea. In the great basin of sedimentary rocks of which we have made mention as covering so large a portion of North America, this sandstone forms the lowest of those stone leaves. It rests immediately upon the bottom of one of the primeval seas, and the other formations repose upon it like so many sheets of paper, each containing certain fossil forms peculiar to itself and not found in any of the others.

Geologists find at the bottom, certain rocks which are not stratified, and which do not contain fossils, these all appear to have been once in a state of fusion, they constitute what may, for our present purpose, be supposed to have been the original surface of the earth. In this original surface there appear to have been certain great cavities, corresponding in size to those occupied by the oceans of the present day. There evidently was a time when the first waters filled those wide and deep gulfs formed to receive them, and we have reason to believe that immediately after this event the filling up of the first oceans with water, commenced the process of forming the first, the lowest, and oldest stratified rock. We cannot say that this latter has yet been discovered. The progress made in the researches of Geologists after the oldest of the stratified rocks has ever been retrograde, that is, a certain set of strata, may be to-day considered the most ancient, but the explorations of to-morrow may shew, that in another place still older layers exist beneath these. From the surface downwards for a distance of about ten miles, all the formations have been examined and marshalled into an order at present pretty accurately ascertained.

The following is the most recent classification of Sir Charles Lyell :—

CLASSIFICATION OF THE FORMATIONS.

A. Post-pliocene.

The Post-pliocene is thus divided :—1. *Recent* consisting of the Peat mosses of Great Britain and Ireland, with the shell marl containing human remains and works of art. The deposits accumulating on the bottoms of the existing lakes and seas belong to this division. 2. *Post-pliocene.*—All the shells found in this formation are of existing species, but there are no human remains ; and of the quadrupeds, whose bones have been found, part are of extinct species. *It appears that the clay, sand, and gravel of the valleys of the St. Lawrence and Ottawa containing sea shells, or the skeletons of marine fish, are to be referred to the Post-pliocene.* The above groups are also called *Post Tertiary.*

B. Pliocene.

The Pliocene is thus divided :—3. *Newer Pliocene* or *Pleistocene.*—

In this formation there are a number of shells of extinct species, about one fourth of the whole, the other three fourths being of species now living in the sea. There are found in this deposit also the remains of many large quadrupeds, some of which still exist, but the great majority being extinct. *During this period nearly all Canada was submerged, and the ocean which covered, it appears to have been full of icebergs. The rounded boulders and great fragments of rock strewn about the fields of this country are supposed to have been transported from the north by the floating ice of the Pliocene ocean.*

4. *Older Pliocene.*—One third of the shells, and nearly, if not all the mammalia, extinct. This formation occurs in Europe, but has not yet been recognized in Canada.

C. Miocene.

5. *Miocene.*—All of the mammalia found in this group are of extinct species. About two thirds of the mollusca are also extinct, and of those which are still existing, many are not to be met with in the neighbouring seas but on some coast more or less distant. The Miocene is not found in Canada.

D. Eocene.

The Eocene is thus divided :—6. *Upper Eocene ;* 7. *Middle Eocene ;* 8. *Lower Eocene.*—None of these occur in Canada, they abound in England, France, and various other parts of Europe. The fossil shells of the Eocene period, with very few exceptions, are extinct. Those which belong to existing species rarely found in the neighbouring seas. All the mammalia are of extinct species, and for the greater part of extinct genera ; the plants found in the upper Eocene of England and France indicate a South European or Mediterranean climate—those of the lower Eocene, a tropical climate. The above groups, B, C, and D, constitute the Tertiary formations. The word Pliocene is from the Greek, *pleion,* more ; and *kainos,* recent : Miocene, is from *meion,* less ; and *kainos,* recent : Eocene, is *eos,* morn or dawn ; and *kainos,* recent. The first name, Pliocene is applied to formations *more recent* than all the others ; Miocene is not so recent as Pliocene, while the Eocene was so called because it was during this period that animals of existing species were supposed to have first made their appearance. It was considered to be the dawn of the existing state of things. A few recent species are, however, found still lower down.

E. Cretaceous.

The Cretaceous rocks, commonly called Chalk Formations, are thus divided :—9. *Maestricht Beds ;* 10. *Upper White Chalk ;* 11. *Lower White Chalk ;* 12. *Upper Greensand ;* 13. *Gault ;* 14. *Lower Greensand ;* 15. *The Wealden.*—The Chalk formations are largely developed in Europe ; a vast sheet of pure chalk several hundred feet in thickness extends in a North-west and South-east direction from the North of Ireland to the Crimea, a distance of about 1,140 geographical miles, and in an opposite direction from the South of Sweden to the South of Bordeaux, a distance of about 840 geographical miles. In North America the Cretaceous rocks extend from North Carolina and Georgia, far up the valley of the Missouri, and may possibly reach the British possessions in the west near the Rocky Mountains. In the chalk, no remains of mammalia have been found, but an abundance of other fossils such as corals, echinoderms, mollusca, fish, and large saurians or lizards. Not found in Canada.

F. Oolite.

The Oolite is thus divided :—16. *Purbeck Beds ;* 17. *Portland Beds ;* 18. *Kimmeridge Clay ;* 19. *Coral Rag ;* 20. *Oxford Clay ;* 21. *Great or Bath Oolite ;* 22. *Inferior Oolite.*—In the Oolitic seas, swarmed great numbers of mollusca and fish of now extinct species, and Genera, together with the Pterodactyls, Plesiosaurs, Isthyosaurs, and other monsters, descriptions of which may be found in many of the common school books of this country : but in addition to these, there existed several species of mammalia, whose remains have been found in the Stonesfield slate. This fact is justly regarded with much interest by geologists, for the reason that throughout the whole of the cretaceous rocks lying above the Oolite no mammalian relics have been discovered. The Oolite is not found in Canada.

G. The Lias.

23. *Lias.*—Beneath the Oolite is the Lias, with fossils resembling in general those of the last group, but specifically distinct. Not found in Canada.

H. The Trias.

The Trias is thus divided :—24. *Upper Trias* ; 25. *Middle Trias, or Muschelkalk ;* 26. *Lower Trias,*—The Trias, or New Red Sandstone formation appears to have been accumulated at a time when the world swarmed with large Batrachians, or creatures of the frog tribe. From the size of some of the numerous footprints in the sandstone of Europe and the United States, it appears that many of these creatures were as large or even larger than an ox. According to Professor Hitchcock, an eminent American Geologist, certain species whose tracks are found in great numbers in the State of Connecticut walked upon two legs like a bird ; between forty and fifty kinds of those tracks have been made out, many of which may have been the impressions of birds. There was at this time, land and land plants, and in the seas were many large fish, but the principal characteristic of the age was the abundance of huge frogs and saurians which infested the sea shores. The teeth of a small mammalian has been discovered in a bone breccia in Würtemberg, in the Trias, and has been called *microlestis antiquus ;* from *micros,* little ; and *lestes,* a beast of pray. Not found in Canada.

I. Permian.

27. *The Permian,* or *Magnesian Limestone.*—The formations above enumerated from the top of the cretaceous to the bottom of the Triassic group constitute the Secondary or Mesozoic rocks, and the Permian is considered to form a transition group between them and the Primary or Palæozoic rocks. The upper portion of the Permian belongs to the Secondary, and the lower to the Primary series. The fossils consist of a few plants,

corals, shells, numerous fish, and some remains of Saurians. The formation is widely spread out over Russia, and occurs also in England, but not in Canada.

K. Carboniferous.

28. *Upper Carboniferous;* 29. *Lower Carboniferous.*—The first of these contains the beds of coal, and is of great thickness in some places. Sir Charles Lyell says, that "in South Wales the coal measures have been ascertained by actual measurement to attain the extraordinary thickness of 12,000 feet; the beds throughout, with the exception of the coal itself, appearing to have been formed in water of moderate depth during a slow, but perhaps, intermittent depression of the ground in a region to which the rivers, were bringing a never failing supply of muddy sediment and sand. The same area was sometimes covered with vast forests, such as we see in the deltas of great rivers in warm climates which are liable to be submerged beneath fresh or salt waters, should the ground sink vertically a few feet." The process appears to have been carried on as follows:—Large tracts of low level and marshy land near the mouths of great rivers remained clothed with vegetation until the fallen leaves, branches, trunks of trees, ferns and reeds, formed beds of vegetable matter several feet in thickness; the land then sank beneath the level of the sea and the surface became covered over with more or less numerous strata of sand and mud. An elevation then took place —a new forest with a new bed of vegetable soil was formed; the country again subsided, and the materials for other strata of rock were spread over its surface, while at the bottom. Thus one bed of coal after another, was formed with layers of limestone, sandstone, or shale between. In the coal mines, the stumps of the trees are often found with roots imbedded in the spot where they grew. In 1852, Prof. Dawson, (now the Principal of McGill College, Montreal,) and Sir Charles Lyell, found in one locality, called the Joggins, in Nova Scotia, 68 of these buried forests one above the other in a depth of 1,400 feet of rock. Mr. Logan had previously ascertained that the thickness of the formation at the same place is 14,750 feet, nearly three miles, so that there may be many others besides those observed. It appears to be well established that coal is entirely of vegetable origin, and that each bed now occupies the spot where the plants from which it was derived grew.—During the age of the formation of the coal the land, was stocked with a most prolific vegetation. In England, Europe, North America, and even in the Arctic regions where only a few dwarf shrubs and mosses now grow; there were in the carboniferous age of the world dense forests similar to those of the tropical regions of the present day. There were many large fish in the seas, and it appears a few air-breathing reptiles on land. The lower carboniferous rocks contain no coal. The true coal measures, or the upper carboniferous formation does not occur in Canada, but a portion of the lower carboniferous reaches Gaspé at the Bay of Chaleur. Both are extensively developed in Nova Scotia and New Brunswick.

L. Devonian.

The Devonian or old Red Sandstone, constitutes numbers 30. ***Upper Devonian***, and 31. ***Lower Devonian*** of Sir Charles Lyell's Tables. These formations are remarkable for the numbers of extraordinary fossil fish they contain, and have been made celebrated by the works of Hugh Miller, the leading geologist of Scotland. Occurs in Canada, Nova Scotia, and New Brunswick.

M. Silurian.

32. *Upper Silurian ;* 33. *Lower Silurian.*—These two formations constitute a large part of the fossiliferous surface of Canada, and will occupy much of our attention hereafter.

N. Cambrian.

34. *Upper Cambrian ;* 35. *Lower Cambrian.*—These are the lowest and oldest rocks known to contain the remains of organized creatures; they are found in Britain, Bohemia, Sweden, the United States and Canada; they are of great thickness, but contain few organic remains. The copper-producing rocks of Lakes Huron and Superior, called ***Huronian*** by Mr. Logan, are supposed to belong to this formation. In Bohemia, where the Palæozoic rocks have been extensively and minutely examined by M. Barrand, this part of the series has been named the ***Primordial zone.*** Sir C. Lyell considers the Potsdam Sandstones of America to belong to the Cambrian rather than the Lower Silurian, to which latter division they have hitherto been referred.

In the following list the names of the formations which have their equivalents in this Province, are given in black letters, so as to shew at a glance what are present and what are absent in Canada :—

ABRIDGED TABLE OF FOSSILIFEROUS ROCKS.

I.—TERTIARY OR CAINOZOIC.

1. **RECENT.**
2. **POST-PLIOCENE.**
3. **NEWER PLIOCENE.**
4. OLDER PLIOCENE.
5. MIOCENE.
6. UPPER EOCENE.
7. MIDDLE EOCENE.
8. LOWER EOCENE.

II.—SECONDARY OR MESOZOIC.

9. MAESTRICHT BEDS.
10. UPPER WHITE CHALK.
11. LOWER WHITE CHALK.
12. UPPER GREENSAND.
13. GAULT.
14. LOWER GREENSAND.
15. WEALDEN.
16. PURBECK BEDS.

17. PORTLAND STONE.
18. KIMMERIDGE CLAY.
19. CORAL RAG.
20. OXFORD CLAY.
21. GREAT OR BATH OOLITE.
22. INFERIOR OOLITE.
23. LIAS.
24. UPPER TRIAS.
25. MIDDLE TRIAS OR MUSCHELKALK.
26. LOWER TRIAS.

III.—PRIMARY OR PALÆOZOIC.

27. PERMIAN OR MAGNESIAN LIMESTONE.
28. COAL MEASURES.
29. **CARBONIFEROUS LIMESTONE**, (Gaspe.)
30. **UPPER DEVONIAN.**
31. **LOWER DEVONIAN.**
32. **UPPER SILURIAN.**
33. **LOWER SILURIAN.**
34. **UPPER CAMBRIAN.**
35. **LOWER CAMBRIAN.**

The foregoing are all the rocks at present known which contain organic remains, and considering that they would constitute, if all of them could be found lying one above the other in their natural order, a thickness of ten miles, composed altogether of the mud and sand which accumulated gradually in the ancient seas, one would suppose that the bottom rocks on which the oldest of these rest would be the original surface of the earth—but it is not so. Below the Cambrian there are other and more ancient stratified rocks which proclaim the existence of seas still more remote in time than those of the Cambrian age. They consist of hard rocks, which, in general have been partly melted and re-consolidated—they are stratified, but much bent and twisted together, and their surface presents unmistakeable evidences of their having been greatly denuded or worn down by the long continued action of atmospheric and other causes before the Cambrian system was deposited upon their often upturned edges. In Canada they occupy the surface of nearly all the country lying on the north shores of the St. Lawrence and Ottawa rivers, and the uninhabited territory between the Ottawa and Lakes Huron. This latter region is also prolonged southwardly into the United States, crossing the St. Lawrence between Kingston and Brockville. The formation has received the name of ***The Laurentian*** from Mr. Logan. The country occupied by it is generally rough and broken up into ragged hills and valleys, with numerous small lakes of beautiful clear water well stocked with fish.

Although these rocks, the Laurentian, are certainly of secondary origin, that is, were formed at the bottom of some vastly ancient sea, after the creation of the world; yet, on account of their wide diffusion, for they, without doubt, underlie all the fossiliferous rocks, they may be assumed for our, present purpose to have been the original surface of the earth. They constituted the floor of the ocean upon which the Cambrian and Silurian rocks were slowly deposited, and in our enumeration of these latter, we shall consider the Laurentions as the foundation supporting all the others.

CANADIAN FORMATIONS.

We shall now proceed to the examination of the Canadian Formations in detail, characterising each briefly, and concluding with a table of their geographical distribution in the several counties of the province, so far as this can be ascertained from the materials in our possession. Commencing at the surface and proceeding downwards, the following is their order and supposed thickness :—

Devonian.	1. Chemung and Portage Groups, ...	7,000
	2. Hamilton Group, ...	1,000
Upper Silurian.	3. Corniferous Limestone,....	100
	4. Onondaga Salt Group, ...	350
	5. Niagara Limestones and Shales, ...	500
	6. Clinton Group, ...	60
Lower Silurian.	7. Medina Sandstone, ...	600
	8. Hudson River Group, ...	1,100
	9. Utica Slate, ...	100
	10. Trenton Limestone, ...	450
	11. Calciferous Sandrock, ...	250
Cambrian.	12. Potsdam Sandstone,.	300
	13. Huronian Rocks, ...	——
	14. Laurentian Rocks.....	——
		11,810

The thickness of the Laurentian rocks is unknown, and that of the Huronian is stated by Mr. Logan at 10,000 feet. Deducting the Chemung and Portage groups, which are only to be found in Gaspé, in this Province, we have for the fossiliferous rocks of Upper Canada the depth of 4,810 feet or nearly a mile; but it is probable that the Hamilton group does not attain its full volume where it crosses the Western peninsula. The other measurements taken principally from the works of the New York Geologists, are probably not far from correct.

The following are some further particulars concerning each of the fossiliferous formations of Canada :—

Potsdam Sandstone.

This formation reposes in most places where it is seen in Canada, immediately upon the Laurentian rocks, the only exception being near Lakes Huron and Superior, where the *Huronian* lies between the Sandstone and the older deposits. It takes its name from Potsdam, a town situated about thirty miles from Ogdensburgh, in the State of New York. It is a sandstone sometimes very compact, almost resembling pure quartz, sometimes fine and often coarse-grained, containing small rounded pebbles; its colour varies from white, yellowish or reddish, to brown. At Potsdam it is very regularly stratified, and splits readily into slabs of a convenient size for building or flagging streets. It yields materials for glass making, and also makes a good lining for iron furnaces. The species of fossils it contains are few in number, but some of them of great scientific interest. In the ancient seas, the materials of which this rock is composed doubtless existed in the form of loose sand drifted about the bottom, and constituting extensive beaches and shallows where sported numerous animals, distantly allied to the crabs and lobsters of the present day, but of a generic form no longer seen. There were a few small shell fish, and it appears a good deal of sea weed in this ocean, as their remains are often found more or less perfectly preserved in the rock.

The Potsdam Sandstone should be found at intervals along the base of the hills on the north shores of the St. Lawrence and Ottawa, from below Quebec, to a point opposite Pembroke. From this latter place it forms an irregular and interrupted belt southwardly through the counties of Renfrew, Lanark, Leeds and Grenville, to the St. Lawrence above Brockville. It also crosses from the Ottawa, near the village of St. Anns, to Beauharnois and thence into the United States. West of the Thousand Islands this rock should be found in a belt extending from the vicinity of Kingston westwardly, in the rear of the counties on the north shore of Lake Ontario, to the south-east corner of the Georgian Bay. It also occurs at the Sault St. Mary.

Calciferous Sandrock.

The Calciferous Sandrock consists of limestone, containing more or less sand—some of the beds are of a shaly character, having the appearance of a drab coloured greenish or yellowish hardened mud, full of petrified sea weeds. The rock called by the farmers in some parts of the country, " Bastard Limestone," belongs to this formation. In the reports of the Geological Survey of New York, it is thus described by Mr. Vanuxem, one of the Geologists who was employed on that important work, " it embraces generally three distinct masses as to character and position—the first is silicious and compact, and may probably be the continuation of the Potsdam Sandstone, either in part or almost wholly."

" The second is a variable mixture of fine yellow silicious sand and carbonate of lime, which, when fractured, presents a fine sparkling grain ; it is in layers, but they rarely shew that very regular structure which usually belongs to a limestone rock. They have a shattered appearance from numerous cracks, the parts being more or less separated from each other."

" The third is a mixture of the Calciferous material, which is usually yellowish, very granular and sparkling when fresh broken, and of compact limestone, which resembles the Birdseye limestone in its mineral character, containing also some argillaceous or slaty matter." *

The Calciferous Sandrock often contains cavities, lined with beautiful quartz, crystals, and sometimes small rounded masses of transparent calcareous spar. It has only a few species of fossils, but contains great quantities of ***Fucoides***, or petrified sea weeds. These are sometimes packed in

*** Report upon the Third District. page 30.**

beds, which decompose readily an exposure to the weather ; the ***Fucoïdes*** partly retaining their form, and resembling small broken sticks or twigs.—The formation rests upon the Potsdam Sandstone, and is seen along the south shore of the Ottawa in many localities from Carillon to the Chatts. At Grenville, and also at Aylmer, it occurs on both sides of the river ; from the middle of the Allumettes Island it extends irregularly south to Prescott, where it crosses the St. Lawrence into the United States. It should be found also bordering the Potsdam Sandstone where this latter formation crosses from Lake Champlain through Beauharnois to the north shore of the Ottawa, above Montreal, thence it should form a band running more or less near to the north shore of the St. Lawrence to the neighbourhood of Quebec. Its position west of Kingston would be along the south side of the line of the Potsdam Sandstone, pointed out in the description of that formation.

The Trenton Limestone.

The rock of this formation may, in general, be easily recognised—it is almost always a pure, grey, blue, buff or blackish limestone, very regularly stratified. Nearly all the good limestone in the inhabited portions of Canada East of Toronto, consists of this very important deposit. The limestones West of Toronto belong to the Upper Silurian, while those used for burning in the country occupied by the Laurentian rocks, are white, and cannot be mistaken for the Trenton formation. Kingston, Ottawa, Montreal, Quebec, and a great many of the towns and villages East of Toronto, are built of materials derived from this rock.

The Calciferous Sandrock is generally of a lighter colour, and mixed with sand as its name denotes, although it contains some beds which resemble the pure limestones of the Trenton series ; a little practice however will enable the student of Geology in Canada to point out the difference. The Trenton formation has been divided by the New York Geologists into four sections, the Chazy, Birds Eye, Black River, and Trenton Limestones, but Mr. Logan considers them all united by their fossils into one. They repose upon each other in the order above indicated, the Chazy being the lowest, the Birds Eye resting on the Chazy, the Black River on the Birds Eye, and the Trenton lying upon the Black River. There are certain fossils peculiar to each of those four divisions of the Trenton Limestone, while there are others which prevail throughout the whole mass, and for the latter reason is it considered to be a single formation. This rock is seen on the River St. Mary between Lakes Huron and Superior, on the Island of St. Joseph, and again at the South-east end of the Georgian Bay ; from this latter locality, it runs eastwardly until it reaches the Eastern extremity of Lake Ontario, and for some distance above Kingston. It is extensively spread out over the country lying between the Ottawa and St. Lawrence, its western limit in this region being the belts of Potsdam Sandstone and Calciferous Sandrock above mentioned, as stretching from the neighbourhood of Pembroke, through Renfrew, Lanark, Leeds and Grenville, to the St. Lawrence. In Lower Canada it is largely developed in the neighbourhood of Montreal.

from which city it runs in one direction down the north shore of the St. Lawrence to some distance below Quebec, and in another direction to Lake Champlain—several bands of it on the south side of the St. Lawrence below Montreal, extend southwardly to the Province line East of Lake Champlain.

Utica Slate.

The Utica Slate, so called after the city of that name in the State of New York, is a jet black shale resembling a mass of hardened mud. Upon exposure for a few months to the air, it turns of a light brown or chocolate colour upon its surface, and finally decomposes into a clay soil of considerable fertility. The rock at the surface is generally seen in small flat slaty fragments, but on penetrating downwards into the deposit several feet, it is found to be very compact, but crossed by numerous joints or fissures in a direction diagonal to the stratification. In the lower part of the formation it includes several thin beds of limestone, with seams of bituminous shale between them, generally full of fossils. According to Mr. Logan's map, published in the Canadian Journal, vol. 3, the Utica Slate borders Lake Ontario in the front of the Townships of Hamilton, Hope, Clarke, Darlington, Whitby, and Pickering. It then leaves the lake and runs in a belt, several miles wide, in the rear of Toronto and north to the Georgian Bay, where it forms the front of the Township of Nottawasaga and part of Collingwood. It forms several long parallel beds in the counties of Carleton, Russell, and Prescott, extending from the city of Ottawa to the neighbourhood of Hawkesbury. It also occurs in the neghbourhood of Montreal and again near Quebec. Between these two cities, on both sides of the St. Lawrence, it has been found in various irregular patches and bands, marked by its characteristic fossils.

Hudson River Group.

This group, which is said to have a thickness of from 1,000 to 1,400 feet, is composed of blue, green, or red argillaceous shales, interstratified with thin bands of sandstone, and occasionally some limestones. It forms the shore of Lake Ontario, from the Township of Pickering to the Credit. The city of Toronto stands upon it, or rather above it, for a deep bed of drift covers the formation in this part of the province. From Lake Ontario it extends back to the Georgian Bay, which it reaches in the Townships of Collingwood, St. Vincent, and Sydenham; further on in this direction it courses along the northern sides of the Manitoulin Islands, where it is accompanied by the Utica slate in a very narrow band. In Lower Canada it constitutes much of the country on the south shore of the St. Lawrence, below Montreal, and is largely developed at Quebec, and at several points in the neighbourhood on the north shore.

The Medina Sandstone.

The Medina Sandstone is composed of red and green coloured marls and slaty sandstones, with a thick bed of grey sandstone at the top, yielding fine building stones, for which purpose it is extensively used—the formation is said to be 600 feet in thickness. The grey band at the summit constitutes the upper surface of the lower Silurian rocks in Upper Canada. The formation skirts the south shore of Lake Ontario, from the Niagara river to Hamilton, and thence continues down the Lake to Oakville ; it thence runs north to Owen Sound and fringes the western coast of the Georgian Bay for several leagues further, it also crosses the Manitoulin Islands in a narrow belt. In Lower Canada it does not appear to have been very decidedly recognized.

Clinton and Niagara Groups.

These are generally considered by the American Geologist to be separate formations distinguished from each other by characteristic suites of fossils. A series of green shales and impure limestones, with a partial bed of fossiliferous iron ore of variable thickness, are the materials of which the first is formed ; and a mass of shale 80 feet thick, overlaid by 160 feet of limestone, constitutes the latter. The Clinton group is estimated by Professor Hall, of the New York Geological Survey, at about 60 feet in thickness. Mr. Murray, of the Provincial Survey, ascertained the thickness of the two groups to be 560 feet on the Manitoulin Islands. These formations have yielded a rich harvest of fossils of the upper Silurian age. They cross the Niagara river between Queenstown and the Falls, in a belt here about 7 miles wide ; they then run westerly, and turning round to the north in the rear of Hamilton, stretch nearly across the counties of Wellington, Wentworth, Bruce and Grey, to Lake Huron. They constitute the long irregular tongue of land which separates this lake from the Georgian Bay, and also all the southern portions of the Manitoulin Islands. They have also been detected by Mr. Logan in the Eastern Townships of Lower Canada.

Onondaga Salt Group.

This formation is a very important one for the agriculturist. It is described as consisting of grey or drab coloured limestones, argillaceous shales, marls and shaly limestones, with deposits of gypsum—thickness probably 350 feet. The gypsum is found in detached masses, often in great quantities, but never in regular strata. It is largely quarried in certain of the western Townships near Lake Erie, where the formation is extensively developed.—The formation enters the upper province in a narrow band between the Niagara Falls and Lake Erie, and proceeds westerly through the counties of Welland, Haldimand, Brant, Waterloo, Wellington, Bruce and Grey, to Lake Huron, at the Townships of Bruce and Saugeen. It has not been distinctly recognized in Lower Canada.

Corniferous Limestone.

The Corniferous Limestone consists of a fine grained, compact, calcarous rock, generally bluesh or greyish, and containing great numbers of hornstone nodules. It may be estimated at the thickness of 100 feet, and it probably includes in its lower portion in Canada a thin formation, called the Onondago Limestone by the New York Geologists. It crosses the western peninsula from Lake Erie to Lake Huron, and probably underlies the greater portion of that tract of country occupied by the counties of Norfolk, Oxford, Perth, Elgin, Middlesex, and portions of several other counties adjoining these. Further west, it occurs in the counties of Kent and Essex.

Hamilton Shales.

This formation is a great mass of dull olive, blue, or black argillaceous and bituminous shales, 1,000 feet in thickness in New York, but probably not so thick in Canada. It occupies portions of Kent, Essex, and Lambton.

Chemung and Portage Groups.

These rocks, or those of the same age, only touch this province on the north side of the Bay of Chaleur, in Gaspé, where they are overlaid by the lower part of the coal formation. They consist of sandstones, and are the equivalents of the Devonian or Old Red Sandstone Group. In Gaspé, they are said to be 7,000 feet in thickness, and constitute the highest rocks of the Geological series in Canada.

In the Tables which follow, an attempt has been made to exhibit in a form convenient for reference all the formations which may be expected to occur in each of the counties of Upper and Lower Canada. We are well aware that there is a probability of its not being correct in some of the particulars it contains. It must be borne in mind that there is no correct Geological Map of the whole Province yet published, and it is almost impossible to arrive at all the meanderings of these belts of rock with the materials for compilation at present extant. The tables, however, will be of use as a guide to the principal localities in a general way, and each reader can fill up with further details from his own district at his leisure. In Lower Canada, the country lying on the south side of the St. Lawrence, below Montreal, has been greatly disturbed by ancient convulsions of nature, and much difficulty will be experienced in ascertaining the boundaries of the tracts occupied by each formation. The whole of this region is Silurian, with the exception of the Devonian rocks in Gaspé, and the Lower Silurian lies next the St. Lawrence, the Upper being inland near and upon the boundary line between Canada and the United States.

The above are the only solid rocks to be seen over nearly all the Province of Canada. In the neighbourhood of Lakes Huron and Superior, what are called trap rocks, are of frequent occurrence. These are considered to have originated during the phenomena of ancient volcanoes. Where the earth has cracked open and the melted matter from the interior has oozed up to the surface and there solidified these trap rocks have resulted. They are also found in Lower Canada. The mountain at Montreal, and others which will be hereafter examined, are examples of trap hills.

UPPER CANADA.

Table of the Geographical distribution of the Formations in the several counties.

COUNTIES.	Laurentian.	Huronian.	Potsdam Sandstone.	Calciferous Sandrock.	Trenton Limestone.	Utica Slate.	Hudson River Group.	Medina Sandstone.	Clinton Group.	Niagara Group.	Onondaga Salt Group.	Corniferous Limestone.	Hamilton Group.	Chemung & Portage Groups
	14.	**13.**	**12.**	**11.**	**10.**	**9.**	**8.**	**7.**	**6.**	**5.**	**4.**	**3.**	**2.**	**1.**
Addington	14	..	12	11	10	..	..	..	..	..	..	..	..	..
Brant	..	..	..	..	..	..	..	..	..	5	4	3	..	..
Bruce	..	..	..	..	..	..	..	..	..	..	4	3	..	..
Carleton	14	..	12	11	10	9	..	..	..	..	..	..	..	..
Dundas	..	—	..	..	10	..	..	..	..	..	..	..	..	..
Durham	..	..	..	11	10	9	..	..	..	..	..	..	..	..
Elgin	..	..	..	..	..	..	..	..	..	..	..	3	2	..
Essex	..	..	..	..	..	..	..	..	..	..	..	3	..	..
Frontenac	14	..	12	11	10	..	..	..	..	..	..	..	..	..
Glengarry	..	..	..	11	10	..	..	..	..	..	..	..	..	..
Grey	..	..	..	..	..	9	8	7	6	5	4	..	..	..
Grenville	..	..	12	11	10	..	..	..	..	..	..	..	..	..
Haldimand	..	..	..	..	..	..	..	..	..	..	4	3	..	..
Halton	..	..	..	..	..	..	8	7	6	5	..	..	..	..
Hastings	14	..	12	11	10	..	..	..	..	..	..	..	..	..
Huron	..	..	..	..	..	..	..	..	..	..	..	..	2	..
Kent	..	..	..	..	..	..	..	..	..	..	..	3	2	..
Lambton	..	..	..	..	..	..	..	..	..	..	..	3	2	..
Lanark	14	..	12	11	10	..	..	..	..	..	..	..	..	..
Leeds	14	..	12	11	10	..	..	..	..	..	..	..	..	..
Lennox	..	..	..	11	10	..	..	..	..	..	..	..	..	..
Lincoln	..	..	..	..	..	..	..	7	6	5	..	..	..	..
Middlesex	..	..	..	..	..	..	..	..	..	..	..	3	2	..
Northumberland	..	..	..	..	10	9	..	..	..	..	..	..	..	..
Norfolk	..	..	..	..	..	..	..	..	..	..	..	3	2	..
Ontario	14	..	12	11	10	9	..	..	..	..	..	..	..	..
Oxford	..	..	..	..	..	..	..	..	..	..	4	3	2	..
Peel	..	..	..	..	..	..	8	7	6	5	..	..	..	..
Perth	..	..	..	..	..	..	..	..	..	..	4	3	..	..
Peterborough	14	..	12	11	10	..	..	..	..	..	..	..	..	..
Prescott	..	..	12	11	10	9	..	..	..	..	..	..	..	..
Prince Edwards	..	..	..	..	10	..	..	..	..	..	..	..	..	..
Renfrew	14	..	12	11	10	..	..	..	..	..	..	..	..	..
Russell	..	..	12	11	10	9	..	..	..	..	..	..	..	..
Simcoe	14	..	12	11	10	9	..	..	..	..	..	..	..	..
Stormont	..	..	..	11	10	9	..	..	..	..	..	..	..	..
Victoria	..	..	12	11	10	..	..	..	..	..	..	..	..	..
Waterloo	..	..	..	..	..	..	..	..	6	5	4	3	..	..
Wellington	..	..	..	..	..	..	..	7	6	5	4	..	..	..
Welland	..	..	..	..	..	..	..	..	..	5	4	..	..	..
Wentworth	..	..	..	..	..	..	..	7	6	5	..	..	..	..
York	..	..	..	..	..	9	8	..	..	..	..	..	..	..

NOTE.—These Tables have been compiled from the valuable reports made to the Legislature by Mr. Logan, of the progress of the Geological Survey of the Province, under his charge. It is understood that he is about publishing, or has published, a Geological Map of great beauty and excellence. In the last number of Silliman's Journal, it is stated that this map will be the best ever executed of any part of America. It will be of the greatest

LOWER CANADA.

Table of the Geographical distribution of the Formations in the several counties.

COUNTIES.	Laurentian. 14.	Huronian. 13.	Potsdam Sandstone. 12.	Calciferous Sandrock. 11.	Trenton Limestone. 10.	Utica Slate. 9.	Hudson River Group. 8.	Medina Sandstone. 7.	Clinton Group. 6.	Niagara Group. 5.	Onondaga Salt Group. 4.	Corniferous Limestone. 3.	Hamilton Group. 2.	Chemung & Portage Groups. 1.
Beauharnois	—	—	12	11	10	9	--	--	--	--	--	...	...	..
Bellechasse	—	—	—	--	--	--	8	7	6	5	--	...	...	..
Berthier	—	—	—	11	10	9	8	--	--	--	--	...	...	..
Bonaventure	—	—	—	--	--	--	--	--	--	--	--	...	...	1
Chambly	—	—	—	11	10	9	8	--	--	--	--	...	...	..
Champlain	—	—	—	11	10	9	--	--	--	--	--	...	...	..
Dorchester	—	—	—	--	--	--	8	7	6	5	4	...	...	..
Drummond	—	—	—	--	--	--	8	7	6	5	4	...	...	..
Gaspe	—	—	—	--	--	--	8	7	6	5	4	3	2	1
Huntingdon	—	—	—	11	10	9	8	--	--	--	--	...	...	..
Kamouraska	—	—	—	--	--	--	8	7	6	5	4	...	...	..
Leinster	14	—	12	11	10	9	8	--	--	--	—	...	...	..
L'Islet	—	—	—	--	--	--	8	7	6	5	4	...	...	..
Lotbinere	—	—	—	--	--	--	8	7	6	5	4	...	...	..
Megantic	—	—	--	--	--	--	8	7	6	5	4	...	...	..
Missisquoi	—	—	--	--	10	9	8	--	--	--	--	...	...	..
Montmorency	14	—	12	11	10	9	8	7	--	--	--	...	...	..
Montreal	—	—	--	--	10	9	--	--	--	--	--	...	...	..
Nicolet	—	—	--	--	10	9	8	--	--	--	--	...	...	..
Ottawa	14	—	12	11	10	--	--	--	--	--	--	...	...	..
Portneuf	14	—	12	11	10	9	8	--	--	--	--	...	...	..
Quebec	14	—	12	11	10	9	8	--	--	--	--	...	...	..
Richelieu	—	—	--	--	10	9	8	--	--	--	--	..	...	..
Rimouski	—	—	12	11	10	9	8	7	6	5	4	3	2	..
Rouville	14	—	--	--	10	9	8	--	--	--	--	...	...	..
St. Maurice	14	—	12	11	10	9	8	--	--	--	...	...	...	..
Saguenay	—	—	12	11	10	9	--	--	--	--	...	...	...	.
Shefford	—	—	--	--	10	9	8	--	--	--	...	...	..	..
Sherbrooke	—	—	--	--	10	9	8	--	--	--	...	...	..	..
Stanstead	—	—	--	--	10	9	8	7	6	5	...	...	..	..
St. Hyacinthe	—	—	--	--	10	9	8	--	--	--	...	...	..	..
Terrebonne	14	—	12	11	10	9	--	--	--	--	...	...	..	..
Two Mountains	14	—	12	11	10	--	--	--	--	--	...	...	..	..
Vaudreuil	14	—	12	11	10	--	--	--	--	--	...	...	..	..
Vercheres	—	—	--	--	10	9	--	--	--	--	...	...	..	..
Yamaska	—	—	--	--	10	9	8	7	--	--	...	...	..	..

service to every student of Canadian Geology, and it is to be hoped that an edition accessible to all will be extensively circulated in this province. It should be observed, with respect to the above Tables, that although the course and whereabouts of the formations can in general be pointed out, yet for the greater part they are concealed beneath the beds of sand clay and gravel which forms the loose soil of the country, and cannot therefore always be seen.

ARTICLE II.—*On the Nomenclature and Classification of the Animal Kingdom.*

For the benefit of the juvenile reader, it appears to be proper in this place to explain, that in classifying objects of natural history, two names are absolutely necessary for each species. If we glance for a moment at any one group of animals, the reason will become apparent. In North America for instance, there are three kinds of Bears,—the black bear, white bear, and grizzly bear,—all of them animals of the same anatomical and physiological structure, yet so widely different in size, proportions and color, that the most superficial observer would not hesitate to pronounce them of three distinct species. A person well acquainted with the appearance of the black bear, upon seeing a grizzly bear for the first time, would at once call it a bear, although very different from the species previously known to him. In conversation, however, in order to make it understood which of the animals might happen to be spoken of, it would be necessary for him to distinguish the subject of his remarks by some word which would designate the species. The word black, white, or grizzly, would serve to point out very clearly which of the three was intended. It arises from the nature of language, that we cannot make ourselves understood, where the animal is one of a group consisting of several well known species, all having a similar structure and the same general form, without using two names for the same object.

The word bear is the generic name, it indicates the genus or family, and is expressed by the latin word ***ursus***, a bear, in scientific books. The words white, black, or grizzly, are the specific names—they serve to point out the species.

The only difference between ordinary and scientific conversation in this respect is, that in the first we use our native language, and in the other the dead languages. Thus the American Bears are classified or named as follows in the two cases :—

Common Name.	Systematic.	Translation.
Black Bear.	*Ursus Americanus.*	American Bear.
White Bear.	*Ursus maritimus.*	Maritime Bear.
Grizzly Bear.	*Ursus ferox.*	Ferocious Bear.
Cinnamon Bear.	*Ursus cinnamomum.*	Cinnamon Bear.

The last species is considered to be a mere variety of ***Ursus Americanus***, although some authors are of a contrary opinion.

During the middle ages the learned men published their books in Latin, and sometimes even in Greek. This circumstance was perhaps the reason why generic and specific names were originally written in those languages, and the practice has been continued, we think, with great benefit to the more wide diffusion of Natural History knowledge. It would be well if there were but one general language ; men could then read the books of all nations without the expenditure of the vast time and mental labour of studying foreign tongues. How many valuable hours would thus be saved ? But since this cannot be, we must resort to the next best substitute and use, so far as may be practicable, those languagues that are the most widely understood.

In the higher institutions of education in all civilized countries, the Latin and Greek languages are taught. A French, German, or Russian scholar who had never acquired the English, would not understand the word "bear," but *ursus* he would at once. There is therefore this amount of gain in retaining the use of Latin and Greek names, that our discoveries, to some extent at least, will be more widely understood. Knowledge is the universal property of mankind, and he who assists with the greatest effect in promoting its diffusion, is the greatest benefactor of his race.

The names employed by Naturalists in their systematic classifications have not always the same meaning as those in ordinary use. Some of the scientific terms are an improvement, others are not. For the animal so well known in Canada, "Black Bear," is not a very distinctive appellation, because there are bears in Europe quite as black as the one which inhabits our forests. ***Ursus Americanus***, "the American Bear," is also somewhat objectionable. It would be very proper if there were but one species in America, but since there are at least three well defined species of American bears, and one or two varieties, it is certainly not a good name. ***Ursus maritimus*** and ***Ursus ferox*** are both sufficiently significant, because the first lives always upon the sea shore and the second is the most ferocious and terrible of all bears.

In no department of the science of Natural History have there been greater difficulties to be surmounted than in that which relates to nomenclature, or the devising of appropriate and significant names. On looking over any large work, it will be seen that a great many of the species have had, each one of them, a number of different names bestowed upon it by various authors, and it often becomes a matter of great perplexity to decide which is the one to be retained.

The rule in such instances is, that the name given by the person who originally or first described the species and published his description, is to be adopted to the exclusion of all others. Some authors describe new species of animals or fossils in so vague and unsatisfactory a manner, that it is next to impossible to recognize the object by the account they furnish of its peculiarities. Such descriptions will apply equally well to half a dozen or more species, and therefore do not serve the purpose of defining clearly which was intended. Difficulties of this nature are common, and many instances will be pointed out hereafter.

The necessity of using two names, the specific and generic, prevails throughout all classes of the animal kingdom, both living and extinct, and as our object is to make ourselves understood, we shall on all occasions where practicable give the translation of the words employed. Where these have been derived from the Latin or Greek, it is in general easy enough to furnish such explanations, but where names of species have been framed out of the names of obscure places or unknown persons, it cannot be done without access to much more extensive libraries than can be found in this country.

The fossils of Canada are for the greater part of extinct species, and in most cases of extinct genera. In order to explain clearly what this means, we shall refer again to our friends the bears. If by some fatality all the black bears should perish, then the species would become extinct—ages might roll away, but *Ursus Americanus* would never once be seen in life. If all the individuals of every species of *Ursus* should perish, then the genus would be extinct. In the British Museum there are preserved the remains of several extinct species of *Ursus*. There is the *Ursus spelæus*, or Cave Bear, whose bones have been found in the ancient caves of several European countries, and the *Ursus priscus*, or the first of all bears. None of these are at present in existence, and their species are therefore extinct, but the genus still survives, and is represented by eight or ten well known and clearly defined species besides several varieties in various parts of the world.

On the other hand, *Ichthyosaurus, Plesiosaurus,* and others, whose figures may be seen in many of the common school books, are examples of extinct genera.

No progress of any value can be made in the study of Natural History without attention to the distinction between genus and species, and to the principles of classification, and we shall therefore quote in this place the remarks of Messrs. Agassiz & Gould, in their recent work upon this subject.

"Every art and science has a language of technical terms peculiar to itself. With those terms the student must make himself familiarly acquainted at the outset; and first of all, he will desire to know the names of the objects about which he is to be engaged.

The names of objects in Natural History are double, that is to say, they are composed of two terms. Thus, we speak of the white-bear, the black-bear, the hen-hawk, the sparrow-hawk; or, in strictly scientific terms, we have *Felis leo*, the lion; *Felis tigris*, the tiger; *Felis catus*, the cat; *Canis lupus*, the wolf; *Canis vulpes*, the fox; *Canis familiaris*, the dog, &c. They are always in the Latin form, and consequently the adjective name is placed last. The first is called the *generic* name; the second is called the *trivial*, or *specific* name.

These two terms are inseparably associated with every object of which we treat. It is very important, therefore, to have a clear idea of what is meant by the terms *genus* and *species;* and although the most common of all others, they are not the easiest to be clearly understood. The Genus is founded upon some of the minor peculiarities of anatomical structure, such as the number, disposition, or proportions of the teeth, claws, fins, &c., and usually includes several kinds. Thus, the lion, tiger, leopord, cat, &c., agree in the structure of the feet, claws, and teeth, and they belong to the genus *Felis;* while the dog, fox, jackall, wolf, &c., have another and a different peculiarity of the feet, claws, and teeth, and are arranged in the genus *Canis*.

The *species* is founded upon less important distinctions, such as colour, size, proportions, sculpture, &c. Thus we have different kinds, or species, of duck, different species of squirrel, different species of monkey, &c., varying from each other in some trivial circumstance, while those of each group agree in all their general structure. The specific name is the lowest term to which we descend, if we except certain peculiarities, generally induced by some modification of native habits, such as are seen in domestic animals.—These are called *varieties*, and seldom endure beyond the cause which occasion them.

Several genera which have certain traits in common are combined to form a *family*. Thus, the alewives, herrings, shad, &c., form a family called Clupeidæ, among fishes; the crows, black-birds, jays, &c., form the family Corvidæ, among birds. Families are combined to form *orders*, and orders form *classes*, and finally, classes are combined to form the four primary divisions of the animal kingdom, namely, the *departments*.

For each of these groups, whether larger or smaller, we involuntarily picture in our minds an image, made up of the traits which characterize the group. This ideal image is called a TYPE, a term which there will be frequent occasion to employ, in our general remarks on the animal kingdom.—This image may correspond to some one member of the group; but it is rare that any one species embodies all our ideas of the class, family, or genus to which it belongs. Thus, we have a general idea of a bird; but this idea does not correspond to any particular bird, or any particular character of a bird. It is not precisely an ostrich, an owl, a hen, or a sparrow; it is not because it has wings, or feathers, or two legs; or because it has the power of flight, or builds nests. Any, or all of these characters would not fully represent our idea of a bird; and yet every one has a distinct ideal notion of a bird, a fish, a quadruped, &c. It is common, however, to speak of the animal which embodies most fully the characters of a group, as the type of that group. Thus, we might perhaps regard an eagle as the type of a bird, the duck as the type of a swimming-bird, and the mallard as the type of a duck."

The following is the sketch of the classification of the animal kingdom given in the work from which the above is quoted,—this system differs in some respect from those in general use at present. We shall point out some of those differences hereafter:—

The Animal Kingdom consists of four great divisions which we call Departments, namely,

I. The department of Vertebrata.
II. The department of Articulata.
III. The department of Mollusca.
IV. The department of Radiata.

I. The department of Vertebrata includes all animals which have an internal skeleton, with a back-bone for its axis. It is divided into four classes.

1. Mammals (animals which nurse their young).
2. Birds.
3. Reptiles.
4. Fishes.

The class of Mammals is subdivided into three orders.

a. Beasts of prey (*Carnivora*).

b. Those which feed on vegetables (*Herbivora*).
c. Animals of the whale kind (*Cetaceans*).

The class of BIRDS is divided into four orders.
a. Birds of prey (*Incessores*).
b. Climbers (*Scansores*).
c. Waders (*Grallatores*).
d. Swimmers (*Natatores*).

The class of REPTILES is divided into five orders.
a. Large reptiles with hollow teeth, most of which are now extinct (*Rhizodonts*).
b. Lizards (*Lacertans*).
c. Snakes (*Ophidians*).
d. Turtles (*Chelonians*).
e. Frogs (*Batrachians*).

The class of FISHES is divided into four orders.
a. Those with enamelled scales, like the gar-pike *Lepidosteus* (*Ganoids*).
b. Those with the skin like shagreen, as the sharks and skates (*Placoids*).
c. Those which have the edge of the scales toothed, and usually with some bony rays to the fins, as the perch (*Ctenoids*).
d. Those whose scales are entire, and whose fin rays are soft, like the salmon (*Cycloids*).

II. Department of ARTICULATA. Animals whose body is composed of rings or joints. It embraces three classes.
1. Insects.
2. Crustaceans, like the crab, lobster, &c.
3. Worms.

The class of INSECTS includes three orders.
a. Those which have jaws for dividing their food (*Manducata*).
b. Those with a trunk for sucking fluids, like the butterfly (*Suctoria*).
c. Those destitute of wings, like fleas (*Aptera*).

The class of CRUSTACEANS may be divided as follows :—
a. Those furnished with a shield, like the crab and lobster (*Malacostraca*).
b. Such as are not thus protected (*Entomostraca*).
c. An extinct race, intermediate between these two (*Trilobites*).

The class of WORMS comprises three orders :
a. Those which have thread-like gills about the head (*Tubulibranchiata*).
b. Those whose gills are placed along the sides (*Dorsibranchiata*).
c. Those which have no exterior gills, like the earth-worm (*Abranchiata*).

III. The department of MOLLUSCA is divided into three classes, namely :
1. Those which have arms about the head, like the cuttle-fish (*Cephalopoda*].
2. Those which creep on a flattened disc or foot, like snails (*Gasteropoda*).
3. Those which have no distinct head, and are enclosed in a bivalve shell, like the clams (*Acephala*).

The CEPHALOPODA may be divided into—
a. The cuttle-fishes, properly so called (*Teuthideans*).
b. Those having a shell, divided by sinuous partitions into numerous chambers (*Ammonites*).

c. Those having a chambered shell with simple partitions (*Nautilus*).

The GASTEROPODA contains three orders :

a. The land-snails which breathe air (*Pulmonata*).

b. The aquatic which breathe water (*Branchifera*).

c. Those which have wing-like appendages about the head, for swimming (*Pteropoda*).

The class of ACEPHALA contains three orders :

a. Those having shells of two valves (bivalves,) like the clam (*Lamellibranchiata*).

b. Those having two unequal valves, and furnished with peculiar arms (*Brachiopoda*).

c. Those living in chains or clusters, like the *Salpa*, or upon plant-like stems, like the *Flustra.—Bryozoa.*

IV. The department of RADIATA is divided into three classes :

1. Sea-urchins, bearing spines upon the surface (*Echinodermata*).

2. Jelly-fishes (*Acalepha*).

3. Polyps, fixed like plants, and with a series of flexible arms around the mouth.

The ECHINODERMS are divided into four orders :

a. Sea-slugs, like the biche-le-mar (*Holothurians*.)

b. Sea-urchins (*Echini*).

c. Free star-fishes (*Asteriadæ*].

d. Star-fishes mostly attached by a stem (*Crinoidæ*).

The ACALEPHA includes the following orders :

a. Medusæ, or common jelly-fishes [*Discophori*).

b. Those provided with aerial vesicles (*Siphonophori*).

c. Those furnished with vibrating hairs, by which they move (*Ctenophori*).

The class of POLYPS includes three orders :

a. Fresh-water polyps, and similar marine forms (*Hydroids*).

b. Marine polyps, like the sea-anemone and coral-polyp (*Actinoids*.)

c. A still lower form, allied to the mollusca by their shell (*Rhizopods*).

In addition to these, there are numberless kinds of microscopic animalcules, commonly called infusory animals (*Infusoria*,) from their being found specially abundant in water infused with vegetable matter. Indeed, a great many that were formerly supposed to be animals are now known to be vegetables. Others are ascertained to be crabs, mollusks, worms, &c., in their earliest stages of development. In general, however, they are exceedingly minute, exhibiting the simplest forms of animal life, and are now grouped together, under the title of Protozoa. But, as they are still very imperfectly understood, notwithstanding the beautiful researches already published on this subject, and as most of them are likely to be finally distributed among vegetables and various classes of the animal kingdom, we have not assigned any special place to them.

ARTICLE III.—*Fossils of the Potsdam Sandstone; Sea-weeds, Shells, and foot prints on the rock at Beauharnois.*

The Potsdam Sandstone once existed in the condition of great beds of sand drifted about the bottom of the ocean, forming wide flat bars or banks, and on the shores extensive level sea beaches. A few rocky desert islands, probably of no great extent, and with a fierce tropical climate, alone marked the position of the present continent of North America. The seas were inhabited, for, in the sandstone, we find the remains of what seems to have been a very remarkable aquatic vegetation, besides a few diminutive shell-fish and the foot-prints of certain extinct animals, concerning whose organization there yet appears to be much doubt. All of these shall receive some consideration in the following article :—

1. Scolithus Linearis.

The fossils to which Professor Hall, the greatest of American Palæontologists, has given the above name, consists of numerous small straight stems which penetrate the strata of sandstone perpendicularly sometimes to the depth of one or two feet. Where they are abundant they have the appearance of a series of small pins or pegs, from $\frac{1}{8}$ to $\frac{1}{4}$ of an inch in diameter, driven into the rock. They are in general cylindrical, but sometimes flattened and even striated. As all traces of their internal structure have long since disappeared, it is impossible to decide with certainty what they may have been. On the margins of the existing lakes and rivers, we frequently meet with localities where in the shallow water fields of straight reeds are growing with their heads above the surface. Were the intervals between these to be filled with sand and be converted into rock, the strata would doubtless present the appearance of those beds of sandstone which are found to be penetrated by *scolithus*. Professor Hall considers them to be the remains of aquatic plants. Others are of opinion that they are holes made in the sand before its consolidation by worms. The fossil occurs in the sandstone in the State of New York, and also in Canada, at Beauharnois—in the Township of Landsdowne, in the County of Leeds, and in several other places.

The generic name *Scolithus* is from the Greek "*Scolax*," a worm : *linearis* Latin, linear or line-like.

In the neighbourhood of the City of Ottawa there are frequently found large boulders of Sandstone which are penetrated by similar straight tubes, but of much greater dimensions. Some of these are four inches in diameter and pass through rounded masses of the rock five or six feet in thickness.—They resemble the trunks of small trees rather than petrified marine plants. As nothing, however, remains to be seen but the straight cylindrical stems, they cannot be referred to any particular family of the vegetable kingdom. The boulders appear to be Potsdam Sandstone, but we are not aware that these large fossils have yet been discovered in the undisturbed beds of the formation; and as most of the loose masses of stone which are to be seen strewn about the surface of Canada have been transported from a greater or less distant source, it is barely possible that they may belong to rocks of some other age.

2. Genus Lingula.

The Lingulæ constitute a genus of small shell fish, several species of which are living in the seas of the present day. Unlike the more commonly known tribes of animated nature, these now under consideration have not the power of free locomotion, but are attached or anchored as it were, by means of a slender flexible stalk, so contrived as to chain the animal to one spot, on the bottom of the sea, throughout its life. Inconsistent as it may appear with our general ideas of what a living creature should be, with reference to its powers of motion, a very considerable portion of the oceanic races are not free, but permanently fixed or grow like a plant to the ground. Of the mollusca thus constituted, some have one of their shells firmly cemented to the bottom, probably by means of an exudation from the shell itself, which afterwards hardens—others by a bundle of hair-like filaments, called a byssus, that issues from the interior and becomes attached to a rock or floating piece of timber, while those of a third tribe are provided with a short stalk, somewhat like that of a flower in form and flexibility. The *Lingulæ* are of the latter class. In the collection of the Silurian Society at the City of Ottawa, there are two specimens of the "duck Lingula," *Lingula anatina,* lately procured from the Indian seas, which have this stalk or pedicle, as it is called, preserved and still attached to the shell. The largest of these specimens is 1¾ inch in length, ¾ of an inch in breadth—of a light brownish colour, and in shape somewhat like a duck's bill, whence its specific name. The pedicle issues out from the interior, through the beak, or the part corresponding to the smaller pointed extremity of the small fossils figured below. It is three inches in length, and one quarter of an inch in breadth, semi-transparent, and in appearance like a dried flat sinew from some quadruped. In its living state, this pedicle is said to be cylindrical, and of the size of a small straw, but flexible and contractile. It confines the animal to a circular space, upon the bottom of the ocean, the diameter of which, in the case of *Lingula anatina* is only about six inches. Within this limited domain, the duck bill Lingula spends the whole of its life, subsisting upon such minute articles of food as may be wafted by the currents, or otherwise brought within its reach. Its diet consists most probably of the smallest animalcule or particles of vegetable matter diffused through the water. The valves, or the two shells, open at the larger extremity, opposite the beak, and while feeding there are protruded two slender flexible arms, fringed with delicate hair-like filaments, called *cirri,* which, by constantly vibrating, cause a current to flow in the direction of the mouth, situated within the cavity formed by the two shells. The possession of those arms has obtained for the class to which the genus Lingula belongs, the name of

Brachiopoda, or arm-footed animals. It comprises about 40 genera,* and more than a thousand species.† All of these are extinct, except about seventy species, living in various parts of the existing seas. There are seven existing species of the genus Lingula known on the coasts of India, the Philippines, Moluccas, Australia, Feejees, and Sandwich Islands. There are about forty extinct species of the same genus described, and they are distributed through all the formations from the Cambrian up to the surface.

Two species are mentioned as occurring in the Potsdam sandstone. They are the following :

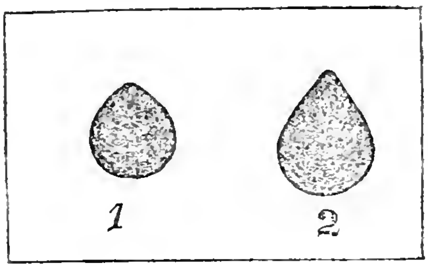


Fig 1. *Lingula prima.*
2. *Lingula antiqua.*

The first of these, ***Lingula prima***, is about the size represented in Fig. 1. It is of an oval shape, obtuse at both ends, but more broadly rounded at the base than at the beak or upper extremity of the above figure. The surface is marked by faint concentric lines, and by a few concentric wrinkles in some specimens. From the base to the beak it is also marked by fine striæ, extending up and down the fossil in that direction. In some cases the latter marks are more distinctly visible than the concentric lines ; but in others both are equally apparent.

Professor Hall states that " this fossil is for the most part rare, even in the Potsdam sandstone, though at Keesville, in Essex County, (State of New York) it is abundant, forming distinct laminæ in the rock, like films of carbonaceous matter." We are not aware that it has been yet discovered in Canada.

The next species, ***Lingula antiqua***, is longer than the other and more pointed towards the beak. The base is broadly rounded, and its surface marked by fine concentric lines, but according to Prof. Hall, no longitudinal striæ are visible.

Mr. Murray, of the Geological survey of Canada, says that this species occurs in the Potsdam sandstone, on Lot 22, in the 9th Concession of the Township of Bastard, in the County of Leeds, and also on Lot No. 11, in the 11th Concession of the Township of Landsdowne, in the same

* See Davidson's classification of the Brachiopoda, in the volume of the Palæontographical Society for 1853, page 50.

† Woodward's Manual of the Mollusca, page 214.

County. In both of these localities it is associated with *Scolithus linearis.*

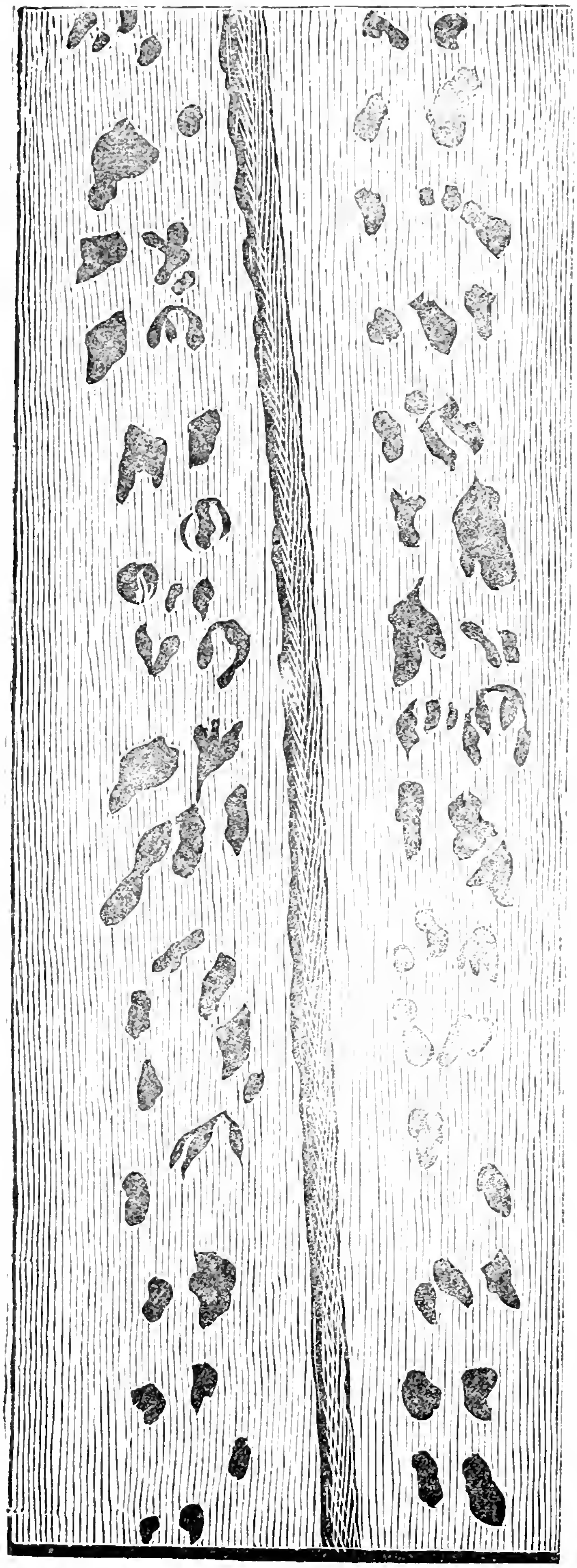
"*Lingula,*" Latin, a tongue; "*prima,*" the first; "*antiqua,*" ancient.

3. Fossil Foot-prints.

The fossils of the Lower Silurian rocks are all of them, so far as is yet known the remains of animals which were confined by their organization to an aquatic life. The mollusks, corals, echinoderms, and trilobites of those ancient formations are all of marine species, but in the Potsdam sandstone which is now considered by some geologists to belong to the Cambrian, there have been found in Canada the tracks of a creature that was evidently an air breather. Perhaps none of the relics of the tenants of the primeval seas have excited so much interest as these extraordinary and as yet unexplained foot-prints.

They are so far from resembling anything yet seen in the formations lying immediately above, that persons familiar with the fossils of the Chazy, Black-river, and Trenton-limestones can scarcely look upon them without suspecting that they are traces of a type of life that belonged to an age widely disconnected by its organic forms from the Lower Silurian. The Lingulæ above figured, it is true, are somewhat similar to species which occur in the Trenton-limestone, but then the fossils of this genus, although ranging through all the formations, do not assist materially in giving a marked aspect to any. We shall here give a short account of the discovery and principal characters of these remarkable impressions.

In 1847, the late Mr. Abraham, then Editor of the Montreal Gazette, announced in his paper that the tracks of a tortoise had been discovered in the sandstone at Beauharnois. He supposed this rock to be the equivalent of the old red sandstone, and, as previous to the publication of his notice no remains of reptiles had been found in formations of so ancient a date, these were regarded by him as particularly interesting. Mr. Logan's attention was afterwards drawn to the discovery, and he soon not only settled the question as to the geological age of the formation, but also had specimens conveyed to England and laid before the Geological Society of London. Professor Owen, in a short paper, read in April, 1851, before the Society, expressed an opinion that the track was that of a fresh water tortoise, but afterwards having been furnished with other and better specimens, concluded that the creature more probably was an articulated animal, and perhaps a crustacean, the class to which our modern crabs and lobsters belong. The localities where these traces of ancient life have been found in the greatest abundance, are situated in that belt of the Potsdam sandstone which crosses from Lake Champlain northerly to the Ottawa above Montreal. There are here large areas consisting of flat surfaces, like so many floors of rock, on which the tracks are seen winding about, and sometimes crossing each other. Each track consists of two rows of foot-prints, with a groove in the rock, about half way between the rows, as if the animal had dragged something after it. The rows are from four to seven inches apart and each corresponds to the impressions made by the feet upon one side of the animal. The wood cut (Fig. 3) is copied from one of the



large engravings in the journal of the Geological Society for 1853. It represents, on a small scale, the tracks of the species which Professor Owen has called *Protichnites septemnotatus*, or the "seven marked" Protichnites. In the original, the width of the track measured across from the outside of the rows of foot-prints, is five inches. The length of the portion figured in the journal is 21½ inches.

This species appears to have been a small animal, flat like a tortoise, but with seven legs upon each side. In walking, the foot-prints made by the feet upon one side of a quadruped, are never opposite those made by the feet of the other side. But in the tracks of Protichnites they appear to be exactly opposite. It is difficult to understand how this could be effected, unless we suppose the animal to rest itself between every step upon the ground, and raise all its legs, move them forward and put them all down at once, in the way that several men in a boat raise all the oars at the same time. It seems thus to have rowed itself, as it were, along the sand. If such were its mode of progression,, then between every step we should expect to find the groove made by dragging its body along deep, where the whole weight rested upon the sand, and shallower while partly raised by the legs in each move forward. Accordingly, Mr. Logan states, "a feature common to all the grooves is, that each repetition or homologue of the foot-prints is accompanied with a deepening and shallowing of the grooves, giving it the appearance of *a chain of shallow troughs,* which, when the impression is light, *are separated from one another by intervals of the ungrooved surface.*" The foot-prints of all the tracks are small and sharp, as if made with a pointed instrument, like the hard sharp extremities of a crab's claw, and instead of seven legs upon each side the animal may have had only two, three, or four, with two or three points at the end of each. Whether this was so or not cannot be yet determined.

In another kind of these tracks the groups of impressions are not opposite, but appear as if the animal had moved the legs upon one side, and then those of the other alternately, throwing itself forward a little each time, with a waddling motion, and making with each move, a plunge in the sand. Professor Owen has given to these last mentioned tracks the name of *Protichnites alternans.* In another species there are eight prints instead of seven. Another shews three grooves, as if the animal had partly floated in the water, dragging its legs by its side. In one, where there is a bend in the track, the median groove verges to the outside of the turn and partly obliterates some of the foot-prints. This track appears to shew that the median groove was made by the tail rather than the body of the animal. In Professor Owen's paper above cited, he has classified these tracks into six species, as follows :

1. *Protichnites septem-notatus*, (seven marked.)
2. *Protichnites octo-notatus*, (eight marked.)
3. *Protichnites latus*, (broad.)
4. *Protichnites multinotatus*, (many marked.)
5. *Protichnites lineatus*, (linear.)
6. *Protichnites alternans*, (alternate.)

In discussing the probable nature of the animal by which these tracks were made, he states in substance that three replies or suppositions may be given. 1st. Either each print was made by the extremity of a single limb, which would give either seven or eight pairs of legs to the animal, according to the species ; or, 2ndly, certain pairs of the limbs were bifurcate, as in some insects and crustaceans, another pair or pairs being trifurcate at their extremities ; and each group of impressions was made by a single so-subdivided limb, in which case we have evidence of a remarkably broad and short hexapod or six legged creature ; or, 3rdly, three pairs of limbs were bifurcate, and the supplementary pits were made by small superadded limbs, as in some crustaceans ; or, 4thly, a single broad fin-like member, divided at its border into seven or eight obtuse points, so arranged as to leave the definite pattern described, must have made the series of those groups, by successive applications to the sand. He thinks the latter hypothesis the least probable of all, and with respect to the first, says, "I confess to much difficulty in conceiving how seven or eight pairs of jointed limbs could be aggregated in so short a space of the sides of one animal ; so that I incline to adopt as the most probable hypothesis, that the creatures which have left these tracks and impressions on the most ancient of known sea shores, belong to an articulate and probably crustaceous genus, either with three pairs of limbs employed in locomotion, and generally divided to accord with the number of prints in each of the three groups, or bifurcated merely, the supplementary and usually smaller impressions being made by a small and simple fourth, or fourth and fifth pair of extremities."

"The *Limulus*, (King crab.) 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 left the impressions on the Potsdam Sandstone."

He states that the animal moved forward, not sideways like some of the crabs, and that in his opinion the median groove was formed by a caudal appendage rather than by a prominent portion of the under part of the body. "What further conjectures," says the learned professor, "the contemplation and comparison of the several series of foot-prints from the Potsdam Sandstone have originated in my mind, I do not deem it very helpful to their full understanding at present to record. The imagination is baffled in the attempt to realize the extent of time past since the period when the creatures were in being that moved upon the sandy shores of that most ancient Silurian sea ; and we know that, with the exception of the microscopic forms of life, all the actual species of animals came into being at a period geologically very recent in comparison with the Silurian epoch. The deviations from the living exemplars of animal types usually become greater as we descend into the depths of time past ; and of this the Plesiosaur and Ichthyosaur are instances in the reptilian class, and the *Pterichthys, Coccosteus,* and *Cephalaspis* in that of fishes. If the Vertebrate type has undergone such inconceivable modifications during the Secondary and Devonian periods, what may not have been the modifications of the Articulate type during a period probably more remote from the Secondary period than this is from the present time ! In all probability no living form of animal bears such a resemblance to that which the Potsdam foot-prints indicate, as to afford an exact illustration of the shape and number of the instruments and of the mode of locomotion of the Silurian *Protichnites*. These most precious evidences of animal life, locomotive on land, of the oldest known sedimentary and unmetamorphosed deposits on this planet, have been, I am well aware, far too inadequately described in the paper which I have the honour to submit to the Society. They offer characters which require more time for their due scrutiny and greater acumen and powers of interpretation than have hitherto been bestowed upon them. The symbols themselves are distinct enough. Old Nature speaks as plainly as she can do by them ; and if we do not fully thereby read her meaning the fault is in our powers of interpretation. In the present attempt I can, however, truly aver that I bestowed upon it all the leisure at my command, and have applied my best abilities in the endeavour to fulfil my obligations to their discoverer, and to satisfy the generally expressed wishes of the Society."

From the above remarks of Professor Owen, one of the most profound comparative anatomists of the age, it will be seen how much mystery still remains to be cleared away from the fossil foot-prints at Beauharnois. Not a vestige of a bone or shell, or any other organic substance, has yet been seen, which can throw any additional light upon the subject. The Potsdam sandstone extends over large areas of the settled portions of Canada, and we would recommend all those interested in Natural History, and who may reside either upon or in the vicinity of the formation, to examine carefully every exposure of the rock in their neighbourhood. He who is the first to discover a ***Protichnites*** will have his name handed down to posterity through we know not how many future geological ages.

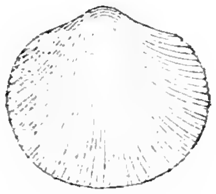
In conclusion, we have only to add, that Protichnites is from the Greek ***Protos,*** the first,—***Ichnos,*** foot-print, or track,—and ***Lithos,*** stone; literally—The first stone foot-prints.

ARTICLE IV.—*On some of the characteristic fossils of the Lower Silurian Rocks of Canada.*

In the last article, we have seen, that from the Potsdam sandstone, a formation 300 feet in thickness, and which probably required a prodigiously long period of time for its accumulation, only a few species of fossils have been procured. We are not, however, to conclude from this circumstance, that the seas in which this ancient rock was formed, were as thinly inhabited as the scarcity of its organic remains appears to indicate. It is well known that in the tropical oceans of the present day, where marine life is most abundant, beds of rocks are in the process of being formed, in which no petrifactions can be discovered. Were some future geologist to judge of the condition of the neighbouring waters, with respect to their animated contents, merely upon such grounds, he might decide that the Pacific was an ocean without corals, mollusks, fish, or other living creatures, while we know that no part of the world is more profusely stocked with animated beings. For aught we know, therefore, the seas of the Potsdam sandstone period may have been full of marine animals, and all that we can say upon the subject is, that if it were so, then their remains have not been preserved.

The Calciferous sandrock, which reposes upon the Potsdam sandstone, is also comparatively barren. Its fossils are not numerous, and they are almost always in a very bad state of preservation. When, however, we ascend to the next overlying formations—the Chazy,—Birds-eye,—Black-river, and Trenton limestones, we abruptly meet with strata packed full of organic remains. If the previous seas were but sparsely inhabited, as some geologists believe, then about the commencement of the formation of these limestones, the water must have been suddenly filled with overwhelming numbers of living things; fossil plants, corals, echinoderms, mollusks and trilobites are to be found in greater or less abundance wherever these remarkable rocks are exposed upon the surface. The whole country between the rivers Ottawa and St. Lawrence, comprising the greater portion of the Counties of Carleton, Russell, Prescott, Glengarry, Dundas, Stormont, Leeds, Grenville, and also small areas in Lanark and Renfrew, are overlaid by enormous sheets of those limestones from 200 to 600 feet in thickness, crowded full of organic remains. There are vastly more animals buried in one cubic mile of the Trenton limestone than there are living at any one time upon the whole continent of America. They are all of extinct species,—nearly all of extinct genera, and many of them, such as the cystideans, orthoceratites, and trilobites, of orders which became wholly exterminated, myriads of ages since.

In the following article we shall give figures and descriptions of some of the most abundant and easily recognized species.



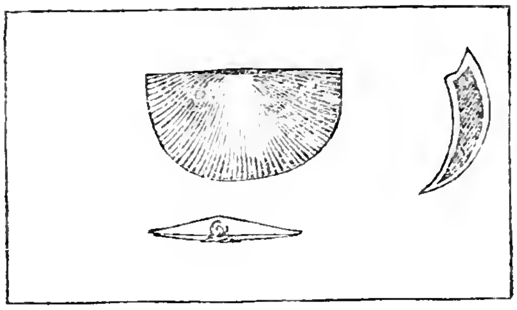


Fig 1. *Orthis testudinaria.* Fig 2. *Leptena sericia.*

Orthis testudinaria.—Fig 1 represents a common species of Orthis, a genus which consists of small fossil bivalve shells, generally of a circular shape, and with one valve more flattened than the other. In this species, the ventral valve above figured is the most convex or rounded of the two. At the upper side or upon the hinge line it projects into a small sharp or moderately obtuse beak. The dorsal valve is nearly straight along the hinge line, flattened or but slightly convex, and in most specimens with a shallow depression which extends from the centre above to the base. The surfaces of both valves are covered with fine elevated lines or ridges which radiate from the beak downwards and outwards. Towards the margin these lines bifurcate, and in very perfect specimens are crossed by numerous delicate concentric thread-like striæ. Often the circular margin at the base is thickened, and appears as if several shells were laid one within the other.

This little fossil is usually of the size of Fig 1, or somewhat less, and the specimens are most frequently found with the valves united and closed in their natural position. It is the most abundant of all the species of this genus found in the Lower Silurian rocks. It is generally seen partly imbedded in the surfaces of the strata of limestone, but often when it occurs in the shale between the beds of the rock it can be obtained perfectly separated and in great numbers. It has a very wide geographical range, as it is found abundantly in the Lower Silurian rocks of Europe, as well as in those of America. Professor Hall says, "a comparison of a Swedish specimen of

Orthis testudinaria with those of New York shews no essential difference; the former being a little more elongated, and the dorsal valve more convex than in the prevailing forms of the Trenton Limestone." In England it is found in the Llandeilo and Caradoc formations of the Lower Silurian. In Canada it ranges from the Black River Limestone upwards, through the Trenton Limestone, Utica Slate, and Hudson River group. In the Utica Slate it is rare, and most abundant in the Trenton Limestone.

The generic name ***Orthis*** is from the Greek *Orthos*, "straight," in allusion to the straight hinge line. The specific name ***testudinaria*** is from the Latin ***testudo***, a "tortoise," this species having a fanciful resemblance to a tortoise. In the earlier works of the American Geologists, this fossil is called ***Orthis striatula***, and it is also so named in Sir Roderick Murchison's new work, SILURIA. It thus appears that there yet remains some difference of opinion as to the correct appellation of the species.

Leptena sericia.—All the species of the genus Leptena have a straight hinge line, and consist of two thin valves, one of which is convex, or rounded, and the other either flat or concave. The small engraving, at the right of Fig. 2, is a section through a specimen of ***L. sericia*** from the beak to the base, and shows how one valve is bent and fits into the corresponding outward curve of the other.

This species is very broad and straight along the hinge line; its width being usually more than twice its length. The ventral valve is convex; the dorsal concave, and the surface is marked by fine striæ, which are even and uniform, or alternating with stronger ones; striæ increasing in numbers towards the margin, granulate or papillose; crossed by a few lines of growth; surface shining." "This beautiful and abundant little shell is readily distinguished by its almost perfectly semi-oval form, with fine papillose striæ, alternating with stronger ones; the latter are often obsolete, and the surface appears uniformly striated.

Very abundant in the Trenton limestone;—Hudson river group, and more rare in the Clinton group. Speaking of this and other species, Sir R. Murchison says, "of the two species of Leptæna which are prevalent in the lower division, the most frequent is ***L. sericia***; which occurring in swarms among the slates of Snowdon, is also frequent in the Caradoc Sandstone of Shropshire and of the Malvern Hills; whilst the ***L. tranversalis***, published originally as a fossil of the Wenlock shale, is now found in Llandeilo formation of Wales and Westmoreland. The former of the two last mentioned species has indeed an universal range; being known in Russia, Scandinavia, Central Germany, the British Isles and America.

Leptena is from the Greek, *Leptos*, thin; *Sericia*, Latin, *silken*, in allusion to the shining or silken exterior of the shell.

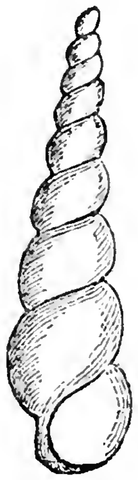


Fig. 3.

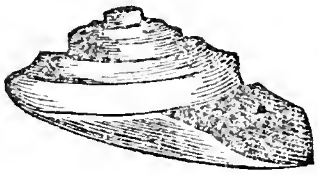


Fig. 4.

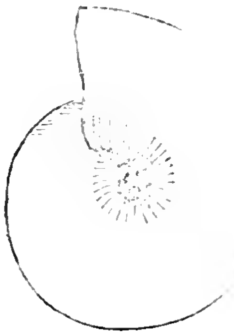


Fig. 5.

Fig. 3.—*Murchisonia gracilis.*
" 4.—*Pleurotomaria umbilicata.*
" 5.—*View of the under side of Pleurotomaria umbilicata.*

Murchisonia gracilis is a long slender spiral shell, generally about the size and of the form represented in figure one. The number of the whorls or turns made by the shell is from eight to ten. They are regularly rounded, and crossed by fine striæ, only to be seen in perfect specimens, and which extend in a direction up and down the shell. From the outside of the aperture a flattened band ascends in a spiral course to the apex, following the centre of the whorls. Neither this, however, nor the striæ are to be seen, except upon specimens that are perfectly preserved. The fossil is usually found in the condition of casts, that is where the shell having been imbedded in the rock, has decayed, leaving an empty cavity or mould of its shape. This having afterwards been filled up with stone, gives a cast of the shell, instead of the petrified shell itself. Such specimens sometimes only present the form of the interior of the fossil. In certain localities, such as at the Chaudiere Falls, at the City of Ottawa ; at Paquette's Rapids, in the Township of Westmeath, and at the third Chute of the Bonnechere river, in the County of Renfrew, it is quite common, in the Black River and Trenton limestones. It is also found in the Hudson River group, but we have never heard of its occurring in the Utica Slate.

The genus Murchisonia was so named in honor of Sir Roderick Murchison, at present the Director of the Geological Survey of Great Britain, and the author of several magnificent works upon the Silurian rocks. It was he who first worked out the Geology of those formations, and gave them the name they now bear, and all the subsequent labours of geologists, in this part of the series, are based upon the results of his researches. The specific name of this species is, in Latin, ***gracilis***, " slender." The genus contains a number of other very beautiful species, some of which shall receive due notice in this journal.

Pleurotomaria umbilicata.—This is another fossil usually found in the condition of casts. The above figure 2 represents very correctly a specimen from the Barrack Hill, at the City of Ottawa. In this species there are three elevated ridges or keels which follow the spiral curvings of the whorls, and produce the angular form seen in the figure. The first of these is situated at the bottom of the whorl, and the side of the shell rises perpendicularly from it to the second placed upon the upper and outer margin—thence there is a curve still upwards, but inwards to the third keel.—Above the first whorl, only two of the keels are visible, the other being buried in the spiral suture between the whorls. The number of whorls or volutions is about four, but some specimens shew more than these. This fossil is seldom found in a perfect state, but even the fragments are easily recognized after a little practice. Figure 3 shews the under-side of a specimen, with the umbilicus or cavity in the centre, around which the whorls are twisted.

The perfect shells of this genus have a notch more or less deep in the outer margin of the mouth or aperture, and hence the name *Pleurotomaria*, from *pleura*, side; and *toma*, a notch. The specific name of this species was given in allusion to the deep umbilicus. It occurs very commonly in the Black River and Trenton Limestones.

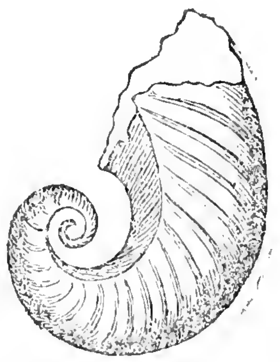


Fig 6. *Cyrtolites ornatus.*

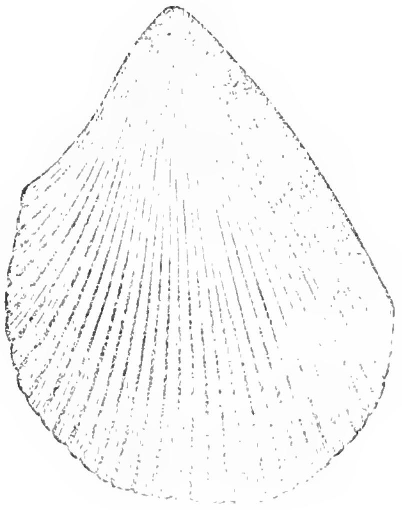


Fig 7. *Ambonychia radiata.*

The first of the above named fossils, like the two preceding, is the shell of a gasteroped, the class of which the existing land snails are well known examples. It is a thin symmatrical shell, and is in its form simply an angular tube, partly coiled up at its smaller extremity. There is no spire, as in the snails, but each side of the coil is equally depressed. The volutions are two or three,—there is a sharp keel on the back and a deep groove on the ventral or inside, next the whorls. The sides are also angulated, and the aperture of a quadrangular shape. The dorsal slopes are marked, says Professor Hall, " by strong transverse ridges, which extend to the angle at the sides of the volution; the surface is marked by fine transverse striæ, the spaces between which are crossed by fine curving ones, giving the surface a cancellated or pitted appearance."

" This fossil usually occurs in the form of casts of the interior, which preserve the form of the shell, the dorsal carina, and the transverse ridges, but not the finer sculpture of the surface." In the perfect specimens, the whorls touch each other, but in those which are badly preserved, they are separate, as shewn in the above figure. This very interesting and often beautiful fossil is not found in neither the Trenton Limestone or Utica Slate, being confined to the Hudson River group. Specimens have been procured at Toronto. In the Trenton Limestone there are several other species of this genus also very beautiful in their form and sculpture."

The generic name is from the Greek, *Kurtos,* curved ; and *Lithos,* stone. *Ornatus,* Latin, *ornamented.*

Ambonychia radiata is one of the most common and characteristic fossils of the Hudson River group. In the system of classification given on page 31 , this and the next following species would rank among the *Acephala* or headless mollusks, of which the common clam-shells of our rivers and lakes are members. Fig 7 is the usual form, although it is frequently much smaller, and not so acute above. The surface is marked by from twenty-five to forty strong radiating ridges which are somewhat flattened upon the top and crossed by fine concentric striæ. The grooves between are rounded on the bottom, and half the width of the ridges.

The name *Ambonychia* is from the Greek *Ambon,* the boss of a shield, and *Onyx,* a claw in allusion to the rounded and claw shaped beak of some of the species, "*Radiata,*" radiated. This fossil is abundant in the Hudson River group, but is not found in any other formation. It was originally called *Pterinea carinata,* and is often quoted by that name in different works.

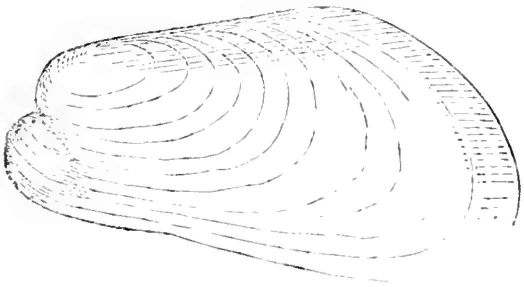


Fig. 8.—*Modiolopsis modioloris.*

This fossil abounds in the Hudson River group, being characteristic of the central and higher portions of the formation. It is of an exceedingly variable form, and is thus described by Professor Hall : "Somewhat obliquely oblong-ovate, narrowed before. expanded and obliquely truncated posteriorly, basal margin usually contracted or slightly arched upwards ; cardinal line extended straight, or slightly curved ; beaks moderately prominent near the anterior extremity ; an oblique scarcely defined ridge, extending from the posterior basal margin ; surface marked by concentric undulations ; muscular impression distinct close to the anterior extremity." In the above figure the narrow end on the left is the anterior, and the other the posterior extremity of the shell. In the living animal, the head and mouth occupied the small end, and hence it is called anterior.

Prof. Hall further states, that, "the fossil presents considerable variation in form, which has given rise to the establishment of several species, founded either upon natural or accidental characters. The more extreme forms might be regarded as distinct, did we not find numerous intermediate ones, showing a gradation from one to the other. The shells, more or less convex, depending on pressure, which sometimes obliterates the prominent oblique elevation extending backwards from the beak. Owing to the same cause, also, the beak is more or less prominent; and the pressure in different directions changes the form of the shell."

This fossil is everywhere found in the central and higher part of the Hudson River group. It occurs at Toronto. In England it is not uncommon in the Caradoc sandstone.

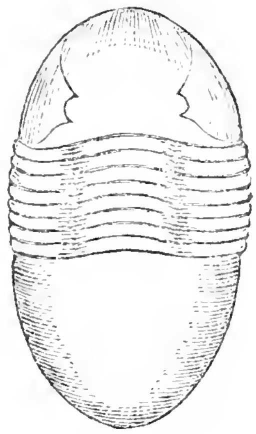


Fig. 9.

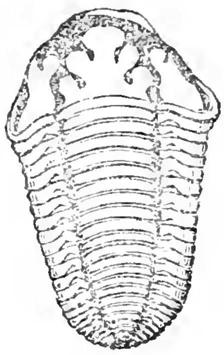


Fig. 10.

Fig. 9—*Isotelus gigas.*
" 10—*Calymene senaria.*

The two trilobites above figured, appear to have swarmed in prodigious multitudes in the seas of the Trenton limestone period. Judging from the abundance of their remains in every part of the great bed of sediment, which constitutes the formation, the ocean was continually filled with shoals of these creatures, similar to the thickend droves of herring and mackerel which are to be met with in the Atlantic at the present day. There were no true fish, or such as have an internal bony skeleton, but in company with the trilobites great numbers of orthoceratites—marine animals, with their bodies inclosed in long tube-like chambered shells, and their heads furnished with powerful arms for capturing their prey, ruled with unlimited sway over all the less formidable tribes of that ancient deep. These two tribes, then the reigning powers among the living things of this world, were in full bloom of strength during the Silurian epoch, but shortly after began to decline, and finally disappeared for ever, about the time of the commencement of the carboniferous period. The most abundant form in the earlier Silurian ocean of *America*, was the *Isotelus gigas*, a figure of which, upon a reduced scale, is given above. All that remains to us of this extraordinary animal is the crustaceous jointed armour with which its head, back and tail were covered. The same remark applies to all the trilobites. It is only the shelly upper covering that has been preserved, while no traces of parts which might show the form of the abdomen, feet, or other organs upon the under side, have ever been discovered, and, consequently, we are as yet totally without any, save conjectural ideas upon the principal portion of their structure.

Isotelus gigas is of an oblong oval form, the two extremities being about equal. The middle portion, or the thorax, as it is called, consists of eight articulations or segments, which at their ends are slightly curved forward and flattened to a thin edge upon their anterior side. The tail, the lower portion of Fig 9. is smooth elevated in the centre, and gradually declining to the margin all round. This part of a trilobite is called the pygidium by palæontologists, and is, in most species, furrowed with grooves in such a manner as to render it somewhat difficult to determine where the line between it and the thorax should be drawn. In this species it is so distinct that no such question can arise. The head is composed above of three pieces, the two outer portions called cheeks, and the central the glabella.—The latter is but slightly convex in this species, but in others, it is elevated and variously lobed. The sutures or lines of division between the cheeks and the glabella, start from the middle of each of the side lobes of the body and curve inwards to the lower corner of the eye, then form a short semicircle half round that organ and thence proceed with an outward curve to the centre of the front part of the head. The eyes are prominent in perfect specimens, and in the shape of a crescent with the angles rounded. The greater number of the species of this race are strongly trilobed by two deep, nearly parallel furrows, which extend from the head to the extremity of the tail. In *I. gigas* only the thorax is much trilobed—the furrows being but obscurely visible on either the anterior or posterior extremities.

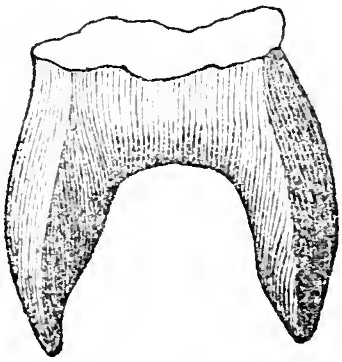


Fig 11. *Hypostoma of Isotelus Gigas.*

Fig 11 represents a part of *I gigas*, called the *hypostoma*, an organ which appears to have been analogous to the *labrum* or upper lip of the insects of the present day. The hypostoma is often found separated from the other portions of the trilobites. The one figured, belonged to an *I. gigas* of medium size. Much larger specimens are occasionaly met with, but generally they are smaller.

In the Trenton Limestone fragments of this great trilobite have the appearance of smooth or slightly punctured pieces of black shell. The head and tail are the parts most frequently found perfect, and are easily recognized; but good specimens with all the parts in their natural connection are exceedingly rare. It is said that they have been seen eighteen inches in length, but from four to eight inches appears to be the prevailing size in our Canadian rocks. *Isotelus gigas* commenced its existence about the period of the Black River Limestone, and disappeared from the seas at the close of the Trenton limestone epoch. The generic name is from the Greek, "*isos*," equal; and "*telos*," end; in allusion to the equal extremities of the animal, "*gigas*," a giant.

Calymene senaria.—This fossil is very distinctly divided, from one end to the other, into three lobes, and thus presents in full perfection the characteristic feature which gave name to the race. The specimens are of an elongated oval form, tapering gradually from the head to the tail. The thorax consists of thirteen segments, each one of which is flattened to a sharp edge on the anterior side, near its extremity, and slightly curved forward, as in ***Isotelus gigas.*** In perfect specimens, the central lobe of the body is much elevated, and forms a strong, rounded semi-cylindrical ridge. The segments of the side lobes are each of them provided with a triangular projection, with its point directed forward, as may be seen in the figure. They are also abruptly bent down at half their length, and near their extremities curve a little outwards. The central lobe of the pygidium or tail, consists of seven segments, and the lateral lobes of four or five each ; these latter are flattened and marked with a small groove along their centres, so that each generally has the appearance of two. A small portion at the extreme point of the tail is not grooved. At the base of the head a strong furrow extends from one angle across to the other, and causes an elevated border upon the posterior margin, which might be readily mistaken for one of the segments of the body. The glabella is much narrower at the front than at the base, and divided into three lobes, on each side. The front lobes are, at least in some specimens, obscurely divided each into two others. The front of the head is turned up into a broad beak. The eyes are small and situated nearly opposite the second lobe of the glabella, and the whole surface, in perfect specimens, is rough, with small irregular granules. This species very much resembles the celebrated *Calymene Blumenbachii*, figured in all elementary books upon the science of geology, and is, in fact, considered by some authors to be the same. It does not, however, agree with the figures given in the best European works, particularly in the structure of the front part of the head. In the English fossil, the glabella extends quite to the margin, but in ours there is a space of about one eighth of an inch in specimens of the size of Fig. 10, between the elevated beak and the rounded front lobe of the glabella. This character alone certainly appears sufficient to warrant a separation of the species. The specimen above figured was found in the Trenton limestone, at the Chaudiere Falls, near the City of Ottawa. The central lobe has been flattened by pressure, so that it appears wider than it would be, had it been preserved in its natural shape. The sides are also a little bent under the body. The specimens of this locality are, most of them, of the above dimensions, although separated heads are occasionally found much larger.

Calymene, Greek, "concealed," *senaria,* "ancient."

ARTICLE V.—*On the Crinoidea or Stone Lilies of the Trenton Limestone, with a description of a new species.*

We pass now to the examination of a very beautiful class of fossil animals, of which the Canadian rocks have furnished some of the most magnificent and interesting specimens yet discovered. The European species have been long known under the various titles of Stone Lilies, Encrinites, or Crinoidea, and although their remains in a very fragmentary state, are perhaps the most abundant of all fossils, yet specimens approaching to perfection are comparatively rare. Few collectors have had the good fortune to discover half-a-dozen of those highly prized palæontological jewels.

In the Trenton Limestone in the neighbourhood of the City of Ottawa, a large number, nearly three hundred—many of them with all their parts, even to the delicate hair-like tentacula which fringed their branching arms, have been collected in a very good state of preservation within the last few years. They constitute between thirty-five and forty new species, and more than one half of them are of genera, hitherto unknown.

This is a very large number to be found in any one formation, and it would thus appear that that portion of the Silurian ocean which covered Canada during the epoch of the Trenton Limestone, was particularly well adapted to the nature of those animals and also to the preservation of their remains. There is plenty of evidence to show that as many as twenty species, some of them of a widely different structure from others, were all living together within an area of two hundred yards in diameter at the same time. That number of species has been collected from the surface of a single bed of the limestone which can be traced uninteruptedly for a greater distance along the cliffs upon the shores of the Ottawa. In the midst of these, or scattered about in little groups, among them, were also eight or ten species of Cystideans—animals closely allied to the crinoids in their structure, but mounted upon a much shorter stem. The long stalks of the crinoids raised their heads generally from two to four feet above the bottom, while none of the cystideans attained a greater height than from three to six inches. The two tribes appear not to have been enemies of each other, because they grew together in submarine fields of considerable extent; the encrinites towering above and overshadowng, as it were, their more humble companions.

As we shall have occasion in this journal to describe some of these fossils, it seems proper in this place to give a general outline of their structure.

The Crinoidea were, at least the greater number of them, of an oval shape, and covered by an armour of small flat plates, which were always of an angular form, and accurately fitted together, so as to enclose the animal completely, like an egg in its shell. Attached to one end was a long flexible stalk, and in or near the centre of the other extremity, a small aperture which served the purpose of a mouth. Around the mouth there were arranged in a circle a number of arms more or less branched in the different species, and fringed on the inside with two rows of tentacula, which most probably, with the arms, were used in capturing such food as the crinoid subsisted upon.

The stalk, at its lower end was attached to the bottom of the ocean, and supported the animal like a flower upon its stem. Such is a general description, which will apply to all the true encrinites. When examined in detail, however, the covering of a crinoid will be seen to consist of a number of flat angular plates arranged according to a certain plan, and so contrived as to constitute an external skeleton, with many moveable parts attached to it, completely under the control of the animal, and exquisitely adapted to the supply of all its wants.

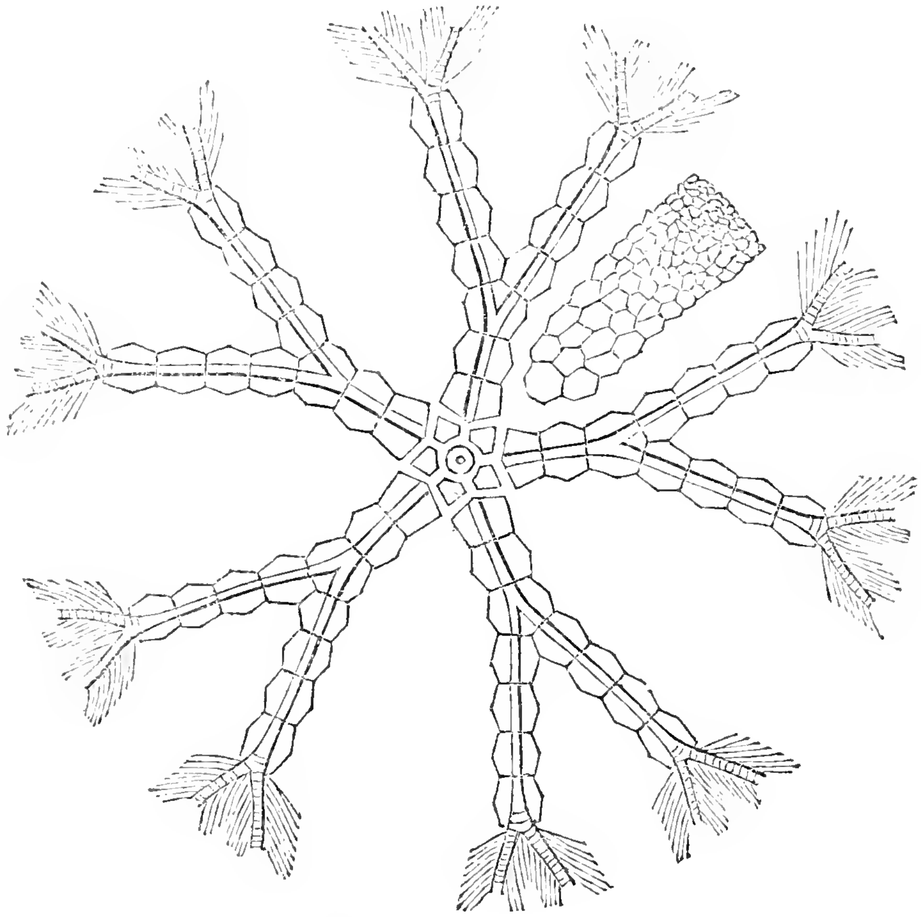


Fig. 1.

Fig. 1 shews the skeleton of GLYPTOCRINUS RAMULOSUS *dissected and spread out upon a flat surface. In the centre, is seen the circular upper joint of the column or stalk ; around it the five pelvic plates ; next, the five* PRIMARY RAYS, *of three plates each, dividing into ten* SECONDARY RAYS, *of four plates each, and lastly, the bases of the twenty* TERTIARY RAYS, *or free arms, with a few of the tentacula attached. In one of the spaces are seen the abdominal or* INTERRADIAL *plates. In the perfect Crinoid, these are also found in the other four interradial spaces.*

On dissecting one of those skeletons, it will be found that resting immediately upon the top of the stalk there are one or more, (in the typical species five,) small plates so arranged as to form a shallow saucer-shaped receptacle, called the pelvis, supporting the viscera and body. From the upper margin of the pelvis there arise five upright rows of other plates, called the rays, which constitute a large portion of the sides of the cup. When spread out upon a flat surface, in their natural order, these radiate from the centre, in the form of a star, and hence the crinoidea are properly considered to fall within the department of the RADIATA.

In many species these rays are divided into numerous branches, but in others they remain single to their extremities. In the branched varieties, the five undivided portions are called the PRIMARY RAYS, and in many species these consist of three flat plates, each as seen in the figures 1 and 2.—Above the PRIMARIES follow the SECONDARY, TERTIARY, QUATERNARY, or QUINARY RAYS. At a variable distance from the base of the body or cup of the Crinoid, the rays become free, or no longer form a part of the general covering of the animal. They are then all called by the common name of ARMS, no matter whether they consist of Secondary, Tertiary, or Quaternary Radials. This liberation of the rays from the walls of the body sometimes takes place near the base, and then even a portion of the Primary rays is included in the arms, but in other genera they do not become free until the third, fourth, or fifth division.

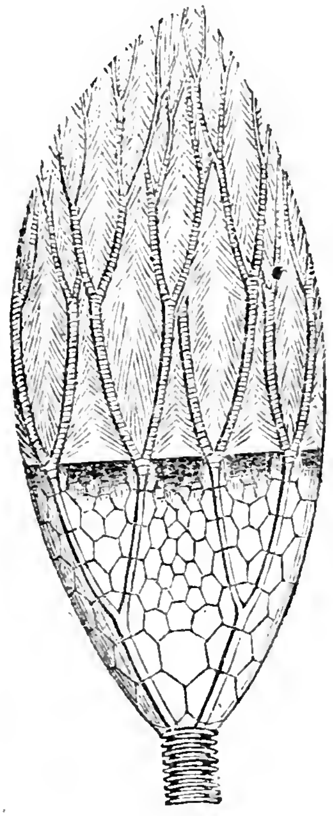


Fig. 2.

Fig. 2 is an encrinite of the genus GLYPTOCRINUS, with the branching arms above, and a short piece of the stalk, at the base. The figure does not represent any particular specimen, but was drawn to give an idea of the cup-like body, with its external skeleton of angular plates and branching arms. It will be observed that the rays, two of which only can be seen in this figure, originate in the base of the body, and proceeding upwards, are blended in the general covering of the animal, until at length they become free at the top and constitute the arms. Hence the arms of a Crinoid are simply continuations of the rays.

These organs constitute the RADIAL SYSTEM of the Crinoids, and can be detected, though often under an extremely modified form, in all the species yet known. In those of the most simple organization, there is little else to be seen—the rays forming the whole of the skeleton, but in others the top of the body, or the abdomen, is covered over by numerous other plates, the abdominal plates, which constitute a firm, dome-shaped roof, filling all the space between the free arms. In the species now living in the sea, the *Pentacrinus caput Medusæ*, this part of the body is covered by a simple leather-like integument, strengthened by small plates, and many of the ancient and now extinct species were similarly constructed. The abdominal plates sometimes extend down the sides, between the rays, nearly to the base of the cup, and form a large part of the sides. The arms are composed of a great number of small joints, articulating upon each other in such a manner as to give the greatest amount of flexibility, and they are each also provided on their inside, towards the mouth, with a groove, more or less deep, and extending their whole length. These were occupied by certain tube-like vessels, which communicated with the interior, through the mouth.

The stalk (called the column by palæontologists) is either round or more or less pentagonal, composed of a great number of joints, and perforated throughout its whole extent, from the cup to the base, by an alimentary canal. The purpose of this channel down the centre of the column, appears to have been to convey nourishment for its growth from the body. In some species it was attached to the bottom by several branching roots, and in others by a broad button-shaped base, consisting of a hardened exudation from the alimentary canal, at the lower extremity.

The columns of the Crinoidea, in a fragmentary state, are among the most abundant of all fossils. The separated joints are to be seen in some of the strata of limestone, imbedded in millions in the rock. They generally occur in the shape of small circular or pentagonal plates, perforated in the centre, and have been known for ages in Europe, under various names. In Britain they were formerly called by the peasantry, "St. Cuthbert's beads," "Screw-stones," or "Pulley-stones;" in Germany, "***Rosenkranzsteine***," rosary-beads; "***Huennenthranen***," giants-tears, or "***Roedersteine***," wheel-stones. Speaking of their numbers, Dr. Buckland says: "We may judge of the degree to which individuals of these species multiplied among the first inhabitants of the sea, from the countless myriads of their petrified remains, which fill so many limestone beds of the transition formation, and compose vast strata of entrochal marble, extending over large tracts of country in northern Europe and North America. The substance of this marble is often almost as entirely made up of the petrified bones of Encrinites as a corn rick is composed of straws. Man applies it to construct his palace and adorn his sepulchre; but there are few who know, and fewer still who appreciate the surprising fact, that much of this marble is composed of the skeletons of millions of organized beings, once endowed with life, and susceptible of enjoyment, which after performing the part assigned to them in living nature, have contributed their remains towards the composition of the mountain masses of the earth."

The Crinoidea were among the first organized creatures that made their appearance in the seas of this planet, and although all the earlier species and genera are extinct, yet the order still exists, and is represented by a single species so far as is at present known, several specimens of which have been procured off the coasts of Barbadoes, Martinique and Nevis. In a work upon the recent and fossil species published several years since in London, the authors state that "the two specimens of this crinoid, *Pentacrinus caput Medusæ*, now in the Bristol Institution, were taken in the Caribbean sea, off Barbadoes; and Mr. Scutchbury informs us that he has reason to believe they were taken by the fishermen at a depth of from fifty to eighty fathoms, in clear water with a rocky bottom. The side arms, and probably the rays, encircled the fishing lines and clung with such tenacity that on the fishermen drawing up their lines the columns became fractured, so that the upper portions of the animals were taken into the boats, and the lower parts left attached to the rocky bed of the sea, thus in a great measure proving that they were fixed by an indurated base of calcarous matter." *

The structure of this existing species of the Crinoidea is of the most simple radiated character. It has a five sided column—five plates in the pelvis—five rays which are free nearly to their base, and three plates in each of the Primaries. They are all subdivided several times, and form numerous feather-like arms. In all the formations, from the Lower Silurian up to the most recent, we find Crinoids, with the same structure of the rays, and it may therefore be regarded as the typical or model form.

There are, however, many genera which exhibit this plan of organization in a greatly modified condition. For instance, the genus Platycrinus has a pelvis of only three pieces, and these are often anchylosed into one, and although it has five rays, yet they consist each of one very broad plate at the base and resting upon it a very narrow one, from the sloping upper sides of which spring the secondary rays. The genus Cyathocrinus has two series of pelvic plates of five each, and with the rays similar to those of Platycrinus, but with the addition of a large abdominal plate between two of the rays on one side. In these and most other genera, no matter how widely differing from the typical form, the radial system can be traced more or less distinctly. In this work, we propose to designate the different plates of the rays by numbers, as follows. The bottom or basal plate of each ray, 1st Radial, the next above it 2nd Radial, and the next 3rd Radial. The secondary rays will be numbered in the same manner as 1st, 2nd, 3rd, and 4th Secondary Radials. The abdominal plates between the rays we shall call Interradials. This is in part the system of nomenclature adopted by Professor McCoy, an eminent Irish Palæontologist, in Professor Sedgewick's recent splendid work, the BRITISH PALÆOZOIC FOSSILS. *

It is a great improvement upon the original nomenclature of Miller, who was the first to prepare a work upon the Crinoidea.

In the Palæontology of New York, vol. 1, five species of encrinites are described as having been discovered in the Trenton limestone within that State, up to the date of the publication of the work, in 1847. In our collection there are more than forty species, about thirty-five of which are from

* Austin's Monograph on recent and fossil Crinoidea, page 111.

* Where there are two series of plates below the rays, as in Cyothocrinus, Professor McCoy calls those of the second series PRIMARY RADIALS also. They do not, however, appear to belong to the rays. There is a new Crinoid figured in Silliman's Journal of July last, which clearly shews that this part of Professor McCoy's system is not capable of general application.

the neighbourhood of the City of Ottawa,—two from the quarries at Beauport, near Quebec, and four or five from other localities. It is probable that the Trenton-limestone will, in course of time, furnish seventy or eighty species within this Province.

The most important Genus, or the one that contains the greatest number of species, in the rocks of this section of the country, has been known since the appearance of the work last referred to, under the name of *Glyptocrinus*, so called on account of the sculptured surface of the specimens first discovered. Many of the strata of limestone appear to consist principally of the plates and broken columns of several species of this very prolific family.

The body or cup of Glyptocrinus consists of five pelvic plates—five primary rays, with three plates in each, and ten secondaries, with from two to five plates each, the number for these latter not being the same in all the species. The spaces between the rays are filled with interradial plates to the upper extremities of the secondary rays. In each of those spaces, at the bottom, there is one large interradial; upon each of these, in four of the spaces, there are two, and in the fifth two or three. Above this point, they become smaller and more numerous. The free arms are long, and either single or more or less branched. The column is round and composed of two kinds of joints, those of one kind are much thicker and broader than those of the other, and as they project upon all sides they produce the annulated appearance seen in the figure below. Some of these columns were probably six feet in length. One of them, in our possession, is 47 inches long, and has evidently lost a piece from each end. Each species of Glyptocrinus has a different form of column from that of all the other species, but still they are all of the same structure, or composed of the thin and thick joints. They are the moniliform or necklace-shaped columns of palæontologists, so called from their resemblance to a string of beads. The plates of the calcarous covering of Glyptocrinus are generally flat and thin. In some species they are smooth; in others variously ornamented by ridges, radiating across them, or by elevated borders round their margins. These superficial markings of the plates together, with the form of the joints, the column and the mode of branching of the arms, are the specific characters. All the specimens of the same species have the same external markings, but all the individuals of the genus have the same structure of the cup, from the base up to the top of the primary rays.

Fig. 3 represents a fragment of limestone, with two of those encrinites partly imbedded in its surface. It was found in a quarry on the shore of Brigham's Lake, a small sheet of water in the Township of Hull, near the mouth of the river Gatineau. In a space of about four yards in length by three in breadth, upon the surface of a thin stratum of the rock, there were about twenty crinoids, all of this species, with portions of their columns still attached. Besides these, there were a number of separate columns lying upon the same surface, several of them crossing each other, and all more or less curved. It appears that on this spot, while it was covered by the ocean, a small group of crinoids had grown, and that owing to some destructive cause they all perished at the same time, and were buried by the deposit of sediment which fell upon them, and formed the thick beds of limestone found resting upon their remains.

Out of all procured at this place, however, there was not one which a palæontologist would call a good specimen. Those figured are crushed, and have the plates broken, eroded and displaced, so that no regularity in their arrangement can be perceived. It is only by examining the fragments of all the cups found in this locality, and comparing them, and establishing their specific identity with others more perfect, found elsewhere, that they can be shewn to be individuals of a species of Glyptocrinus.

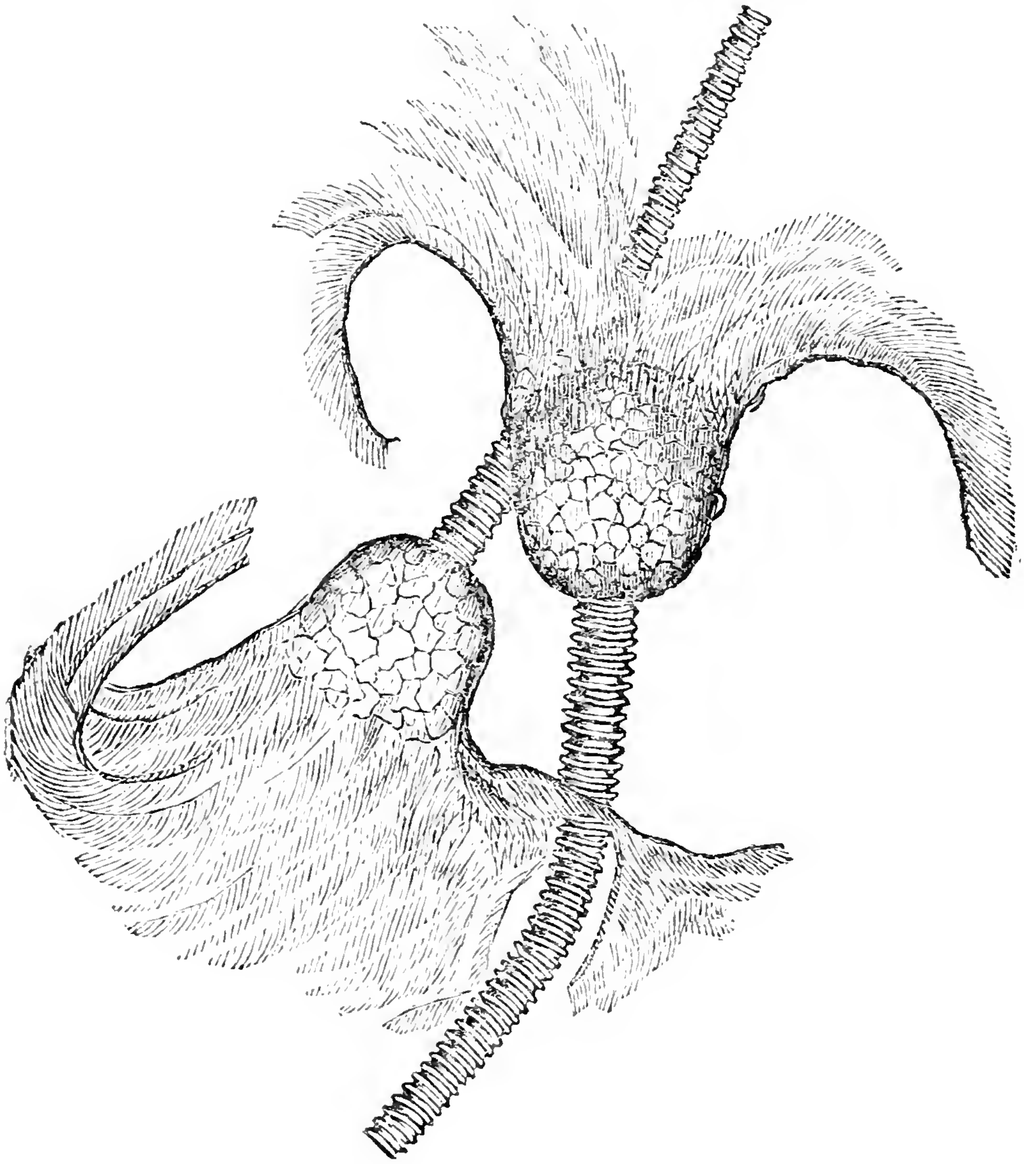
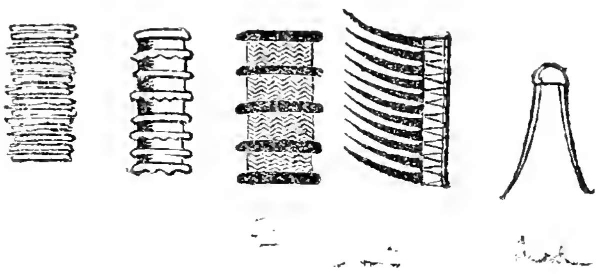


Fig. 3.—Glyptocrinus ramulosus. New species, Trenton limestone, Brigham's Lake, Township of Hull, County of Ottawa.

Description.—The body or cup of this species is covered with smooth plates, and broadly rounded or obscurely pentagonal at the bottom. The height is about equal to the diameter at the base of the free rays. Five strong rounded ridges or keels proceed from the base up the sides, following the centre of the rays, as shewn in Fig. 2. Upon the third plate from the base of each ray, the ridge divides into two branches, which proceed up the secondary rays to the base of the free arms. There are four plates in each of the secondary rays. The pelvic plates are small and barely visible, being in part concealed beneath the basal plates of the rays. They have a projection at their bases, which forms a ring all round under the base of the cup. In some of the specimens this ring is sharp and overhangs, as it were, the top of the column. In other specimens it is thicker and rounded.

The free rays or arms are, at first, twenty; two springing from the top of each secondary ray. At the height of about three fourths of an inch, in specimens of the size of those above figured, they again divide, a few of them, however, (the precise number not ascertained) continuing single to their extremities. They are fringed on their inside with two rows of tentacula, from two-eighths to five-eighths of an inch in length. The arms are composed of two series of ossicula, which interlock with each other, as shewn in Fig., 7 where a side view of a portion of an arm, with its tentacula attached is given. On the back of one of the arms, at its base, eight joints were counted in the length of one eighth of an inch. but higher up they are more numerous. It has not yet been ascertained with certainty whether the tentacula were jointed or not- Each appears to have four or five joints.



Figs. 4 5 6 7 8

Fig 4.—*Is a very accurate drawing of a portion of the column immediately next to the base of the cup.*

Fig 5.—*Is a portion of the column several inches below the base of the cup.*

Fig 6.—*Shews the crenulated thin plates of the column between the thicker ones.*

Fig 7.—*A side view of a portion of one of the arms.*

Fig 8.—*A section across one of the arms; the two long processes below are tentacula. The straight line across the base of the small half circle at the top of this figure should be arched upwards to shew the groove in the arm.*

The column is round and annulated, the projecting rings being very close to each other, and most of them thin and sharp at the base of the cup and for a short distance below. They are farther apart and their edges are thicker and rounded, or slightly notched in the remainder of the column.—At the distance of ten inches from the base of the cup, and thence downward, there are from 16 to 20 annulations in an inch on an average in several specimens. Between the annulations, the column is composed of thin plates with crenulated edges, the angles fitting into each other, as seen in the enlarged figure 6 above. There are from five to ten of those thin plates between each two of the projecting rings. When the number is thus large, one of them in the centre increases in thickness, and forms a new annulation. The edges of the rings are bent very slight downwards, and each alternate one (in all the specimens examined,) in the lower part of the column is notched on the underside, as seen in fig 5. The columns are much larger at the top than at the bottom. One specimen tapers from one fourth of an inch at the base of the cup to one eighth, at the distance of fifteen inches below. Others become more rapidly small, while some of them are more gradual in their decrease. The length for individuals of the size above figured would be from twenty-four to thirty inches.

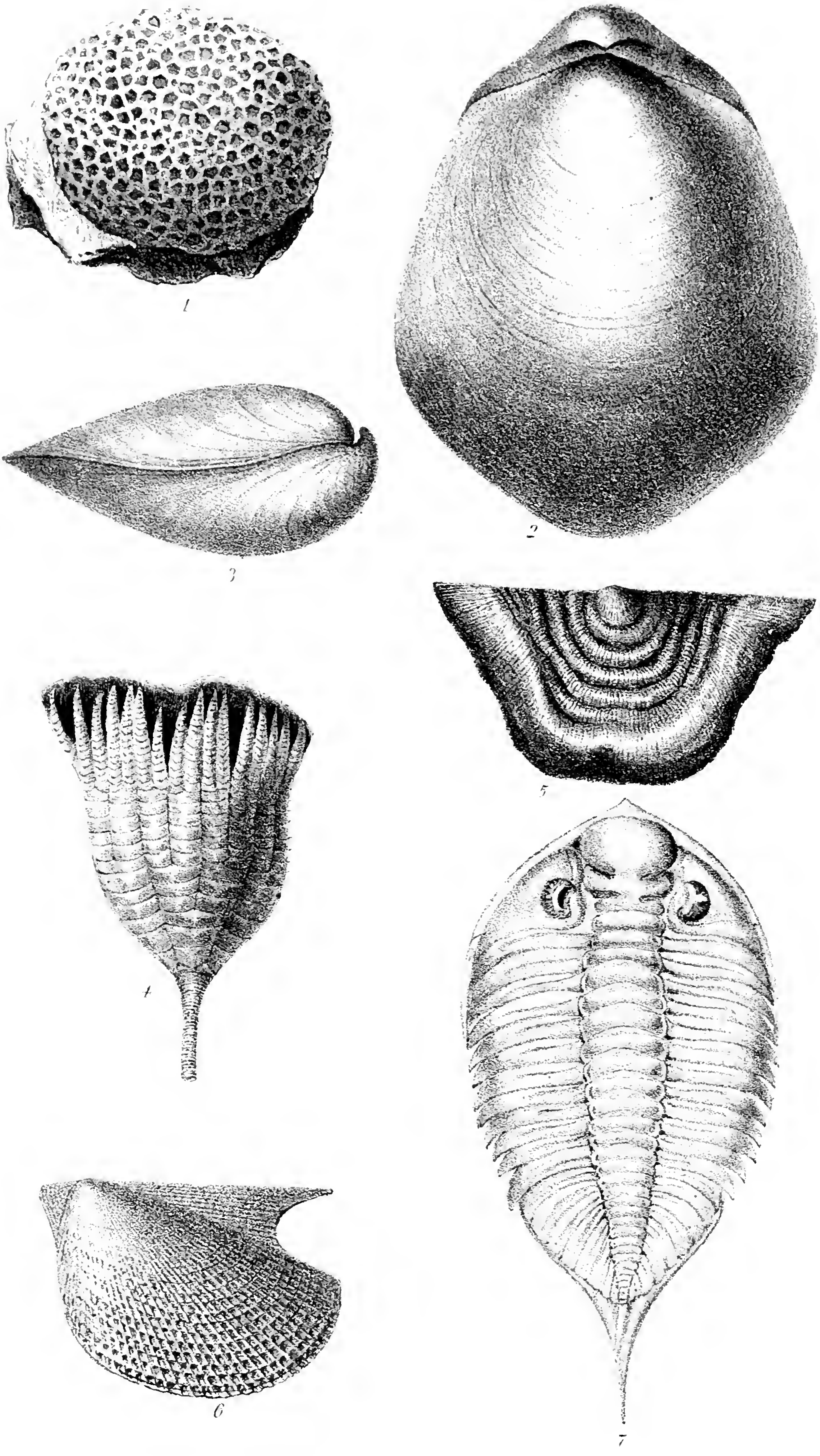
The form of the alimentary canal varies a great deal in different parts of the same column, being in general more or less star shaped with five rays, but sometimes circular. The separate thicker joints are usually seen in the shape of a flattened ring with the outside margin thick and rounded, but thinned down to a sharp edge around the perforation in the centre.

We think this species grew to a great size, there are columns in the Trenton Limestone on the Ottawa river more than half an inch in diameter at the larger or upper extremity, and which when perfect appear to have been six feet in length. Their form is the same as in this species, except that the annulations are not notched at the edges. The plates of the cup are smooth—the rays are keeled—there are four plates in each of the secondaries—the arms are branched and composed of very numerous thin and flat joints. We think these are large full grown specimens of *G. ramulosus.*

The exceedingly prolific genus Glyptocrinus was established by Professor Hall, in 1847, in the first volume of the Palæontology of New York, and he there describes a very beautiful species *G. decadactylus* from the Hudson River Group. Afterwards, another species, *G. Basalis,* was found in North Wales, at Alt, yr Anker, Meifod, Montgomeryshire, in Lower Silurian Slates of an age nearly the same as that of the Trenton Limestone. It is described in Sedgewick and McCoy's British Palæozoic Rocks, page 87. A figure of the same species is given in Sir Roderick Murchison's new work, SILURIA, page 180, where it is stated that "fine specimens are to be seen in the Cabinets of the Museum of Geology in Jermyn Street, and in the Woodwardian collection of Cambridge." The surfaces of both of these species are ornamented with radiating bars or ridges which cover them with a net work of triangular spaces. The name of the genus, *Glyptos*, "sculptured" and *Krinos*, "lily," was suggested by the beauty of this peculiar ornament. Our species differs from both, not only in its smooth plates but in many other respect, and it is therefore to be considered new. It is proposed to designate it by the specific name *ramulosus,* in allusion to its branching arms.

There is another species of *Glyptocrinus* also of great size, but with the plates of the cup bordered by an elevated margin. Only one head of this species has been found.

Professor Hall has figured and described an encrinite under the name of *Schizocrinus nodosus,* the columns of which have the same structure and



FOSSILS OF THE NIAGARA AND CLINTON GROUPS.

J. H. Bufford's Lith. Boston, Mass.

form, nearly of joints, as the new species above described, The annulations are further apart, however, and if we understand figure 10, on plate 27 of the Palæontology of New York, the notches are upon the upper side of the rings instead of the lower, as in this species. We have seen many columns of *G. ramulosus*, which appeared to be perfect at their lower extremities, as they were tapered down to a very small size—but have never met with one still attached to the rock. We cannot therefore say how it was attached, whether by a branching root or by an expanded base, as in many other species. They are usually found coiled up, and the centre of the coil being the small end.

ARTICLE VI.—*Fossils of the Upper Silurian Rocks, Niagara and Clinton Groups.*

The fossils figured upon the plate opposite this page, are somewhat common in the Niagara and Clinton groups, two formations which constitute the most important portion of the Upper Silurian of Canada, so far as palæontology is concerned. These rocks cross the Niagara river, from the State of New York into Canada, in a narrow belt, which pursues a westerly course through portions of the Counties of Welland, Lincoln, and Wentworth, to the City of Hamilton, and then turning to the north, stretches away through Halton, Peel, Wellington and Grey, to the Georgian Bay. Along this line of country a rich harvest of beautiful fossils may be collected. Those upon the plate are :

Fig. 1.—*Favosites Niagarensis.*
" 2.—*Pentamerus oblongus* (dorsal view of a large specimen.
" 3.—*Ditto* *ditto* (side view of a small specimen.)
" 4.—*Ichthyocrinus lævis.*
" 5.—*Strophomena depressa.*
" 6.—*Avicula emacerata.*
" 7—*Phacops limulurus.*

Fig. 7 exhibits the form of a trilobite, closely resembling *Phacops caudatus*, a species very common in the Silurian rocks of England, and one of the most celebrated and best known fossils of this remarkable tribe in the world. Our species is of an elongated oval shape, with the tail prolonged into a sharp spine, and with a short rounded point in the centre of the front margin of the head. There are eleven segments in the thorax, fifteen in the central, and eight in each of the lateral lobes of the tail or pygidium. The head is in the shape of a crescent, with the posterior angles extended backwards, and forming two sharp points. The glabella consists of one large elliptical lobe in the front, and three smaller lobes behind, which are elongated in a direction across the head, between the eyes. Each of the lateral segments of the body is obtusely pointed,—bent downwards at its outer extremity, and grooved upon its upper surface for a distance of two-thirds of its length from the central lobe of the body outwards; the lateral segments of the tail are also grooved, and terminate in a thickened continuous margin which borders the whole of the posterior edge, and is extended into the terminal spine. The tail, pygidium, or caudal shield, as it is variously called, consists in the trilobites of only one piece, and what appears to be its division into segments are only furrows in its surface, arranged in the direction of the articulations of the body. In a recent large work upon the trilobites of Bohemia, (*Systeme Silurien de la Boheme*) its Editor, M. Barrande, shews that the young animals have but two or three segments in their body, and that as they become older others are developed out of the caudal shield. The front part of the shield is first furrowed across, and in course of time this furrow deepens, until it finally cuts off a new segment, which thereafter belongs to the body. One segment after another thus separates itself from the tail, until the animal has attained the number of the adult individual. In many genera of trilobites, such as Calymene and Phacops, the furrows upon the pygidium appear to mark out so many segments of the body, which never become completely developed. In others, such as Isotelus and Illænus, the tails are smooth, and not at all, or only very slightly furrowed.

The eyes of this species are of a crescent form, with the convex curve outwards, and they are on this side, the outside, covered with numerous small lenses. The structure of this organ is thus compound, like that of certain insects. In *Phacops caudatus*, the English species, there are "about 240" in each eye,* and it is probable that the American species has near the same number. This is the most abundant trilobite in the upper silurian rocks of America. In Hall's Palæontology, it is called a Phacops, but in the more recent classification, adopted by Mr. Barrande, in the work above quoted, that genus is divided into two, *Phacops* and *Dalmanites*. It is in the latter genus that our species will most probably be classed hereafter.

Phacops from the Greek *Phakos*, a "lens;" and *Ops*, the "eye."—The specific name is probably from *Limulus*, the "king arab," and *Oura*, a "tail," this trilobite having a tail like that of the king crab.

Pentamerus oblongus is a fossil shell peculiar to the Clinton group, and of a very variable form. It is generally of an oblong oval shape, with a surface either smooth or but slightly marked by faint concentric lines. In old full grown shells there are several concentric ridges, indicating stages of growth. Professor Hall says: "In the smaller and medium sized forms, the shell has a general oval or ovate form, sometimes slightly trilobate at base, it is so much depressed, that the thickness or depth of both valves is only about half the width. This proportion sometimes continues even in very old shells, the trilobate character of the base being often very conspicuous. In the majority of the specimens, however, the valves become gradually more gibbous as the shell increases in size, and the trilobate

* This is the number given by Mr. Salter, in the 2nd Decade of the Geological Survey of England, and he states that the number 400, given in Buckland's Bridgewater Treatise, was probably intended for both eyes

character may be either preserved or entirely lost. Although the general and prevailing form is oval or ovate, yet we not unfrequently meet with forms that are roundish, and the ventral valve wider than long." Figures 2 and 3 are examples of two of the shapes in which this species occurs. It is very abundant in the Clinton group, and is also found in the Caradoc formation in England.

Pentamerus, Greek; 5-partite, in allusion to the 5 chambers inside of the shell of this genus.

Ichthyocrinus lævis.—The encrinites of the genus Icthyocrinus have a round slender smooth column, five plates in the pelvis and five primary rays, but no interradial plates as in Glyptocrinus. The rays are subdivided into secondaries, tertiaries, &c., at irregular intervals, and the free arms are composed of single flat plates, like those of the cup below. It does not clearly appear from the descriptions of this genus given by the different authors, whether or not, the primary rays consist always of three plates. Professor McCoy says three, but Professor Hall says that the first subdivision takes place upon the fourth or fifth plate from the pelvis. This species is very often found with its arms folded up over the summit. It is considered by some geologists to be identical with the *I pyriformis* of the Dudley Limestone in England. It certainly resembles it very much. Sir R. Murchison says the English species "extends its range to North America," having allusion, no doubt, to the one now under consideration. It is found in the Niagara shale at Lockport, and will probably be discovered in Canada.—The name appears to have been derived from *Icthys*, a fish; and *Krinos*, a lily; *Lævis*, smooth.

Strophomena depressa, fig 5, is a fossil of a genus closely allied to *Leptena.* It has a straight hinge line, the surface of the shell is flat and furrowed by strong concentric undulations, and the margin at the sides and base is abruptly bent down. It is often the same breadth above as it is at the base, and it is then of a square shape, with the two lower angles rounded. The surface is also marked by radiating lines; fig 5 is a specimen full grown, but they are sometimes much smaller and not so broad above in proportion to their size. This species is also known by the name of *Leptena depressa.*

The generic name Strophomena is derived from the Greek, *strophos*, bent; and *mene*, crescent, in allusion to the shape in which one valve is bent under the other. In the first reports of the New York Geologist, this fossil is called *Strophomena depressa.* In the second volume of the Palæontology of New York, it is designated *Leptena depressa.* In a recent and beautifully illustrated memoir upon the *Brachiopoda* of Great Britain, by T. Davidson, Esquire, F. G. S., published in the works of the Palæontographical society of London, the genus *Leptena* is divided, and this species falls back into the section *Strophomena*, which will henceforth most probably, include several other American fossils now classified in the genus *Leptena.* This fossil is also known as *Leptena* or *Strophomena rhomboidalis.*

It has a very extensive geological range. Sir R. Murchison says: "The universally spread *Leptena depressa,* now more correctly referred to the genus Strophomena, extends upwards throughout the whole series from the very oldest beds of Llandeilo to the upper Ludlow rock."—SILURIA, page 186. Professor Hall says: "This species has a wide range, occurring in the Clinton group, and ranging to the Upper Helderberg limestones; and if we include the similar or identical species Leptena tenuistriata as the same, we have the example of a species ranging from Lower Silurian to Devonian, and traversing three systems of strata."—PALÆONTOLOGY OF NEW YORK, Vol. 2, page 258.

Avicula emacerata (Fig. 6) is a very pretty shell, not uncommon in the Niagara group. Prof. Hall, says:—"It is easily recognised by its left valve (the one figured) the strong rays of which are regularly cancellated by concentric striæ. The right valve is rarely seen, and it appears to have been extremely thin and fragile, nearly or quite flat, marked on the body of the shell by concentric lines only, while the wing has sometimes a few obsolete radiating striæ. In consequence of the depressed form of this valve, the line of separation between the wing and the body of the shell is not distinctly marked." The extent of the posterior wing, the long projecting point above in the figure, is variable, and the anterior wing, or that at the left angle above in the figure, is sometimes curved downwards.

Avicula, "a little bird;" *Emacerata,* thin.

Favosites Niagarensis.—Fig 1 is an example of a very extensive group of corals, abundant in the Silurian rocks. They are usually met with in the form of rounded or irregular shaped bodies, covered all over with angular cells, and thus have the appearance of petrified honey combs. Each of those cells, however, is the stony tube-like skeleton of one of those marine animals, which, in the present age, furnish by their growth, materials for the extensive coral reefs of the tropical oceans. As the corals, on account of their abundance, require much consideration, we shall in another place enter into the examination of their structure somewhat in detail, and shall defer until then any further notice of the species figured in the plate.

ARTICLE VII.—*Natural History of the Moose Deer, Alces Americana.*

There are, according to the more recent systems of classification, forty-two species of ruminating animals properly included within the limits of the family CERVIDÆ. The greater number of these are remarkable for their beauty, strength keen sense, of sight and smell, and above all for their swiftness in flight. They are in general of an agile graceful form, with a slender but muscular neck, small tapering head, large lustrous eyes, and long sinewy and powerful legs, their principal protection against their enemies being in speed. Certain species herd together in vast droves, preferring wide grassy plains, open forests and hills of low elevation, but never frequent rugged and high mountains, like the chamois and goat.

The males, and in some species the females, are provided with solid branching horns or antlers, which fall off and are renewed each year, becoming larger and more numerously branched as the age of the animal increases.—The greater number of deer also have immediately below the eyes, lachrymal sinuses or "tear pits" as they are sometimes called. These consist of small oval sacs or folds of the skin, constituting cavities of greater or less depth, the size varying with the species or individual. The function of these organs has not yet been ascertained. Many zoologists suppose them to be in some way connected with the respiration of the animals, enabling them to breath more freely in their long flights, while others imagine them to be accessary to the sense of smell or sight. Notwithstanding these opinions, however, they do not communicate with either the eye or the nostril, and it is quite clear that their use in the physiological economy of the animal, is not at all understood. They may be observed immediately below the eyes of the common deer of Canada.

The deer are distributed over every quarter of the world with the exception of Australia and the central regions of Africa. Nine species, belonging to three genera, have been described as inhabiting North America, and of these, six species range into the British possessions, the other three being confined to the South Western portion of the continent, in the region of Oregon, California, and thence southwardly. We shall, in the following articles, give an account of those found in the British territories, commencing with the Moose.

ALCES AMERICANA.

The Moose Deer, the largest of the family known in the world, is still

NOTE.—The following are the deer of North America:—1. The Barren Ground Caribou (*Tarandus arcticus.*) 2. The Woodland Caribou *Tarandus hastalis.*) 3. The Moose Deer (*Alces Americana.*) 4. The Wapite or Canadian Stag (*Elaphus Canadensis.*) 5. The Mule Deer (*Cervus macrotis.*) 6. The Common Red Deer (*Cervus Virginianus.* 7. The Black Tail Deer (*Cervus Lewisii.*) 8. The Long-tailed Deer (*Cervus leucurus*) 9. Richardson's Deer (*Cervus Richardsonii.*)

The moose deer has been described under a variety of names. Until lately it was included within the genus Cervus, but at present the best authorities appear to be of opinion that the European Elk and the American species are sufficiently distinct from other members of the deer tribe to constitute a genus by themselves. When we look at the huge size, short, stiff neck, and long flexible upper lip of the moose, the animal certainly appears to be of a structure widely different from that of the long necked and graceful deer most common in our forests. In the arrangement of the deer, in the English Encyclopædia of Natural History, just published, the European elk is called *Alces malchis*, and the editors appear to regard the American moose as the same species. Perhaps it is; but as it has always been found, heretofore, that no matter how much the animals of the two continents may resemble each other, when actual specimens are placed side by side and compared, the result is a separation of the species, it appears to be the better course to consider these animals distinct, until the contrary is proved. In a paper by Professer Baird, of the Smithsonian Institution, the moose is called *Alces Americana*, and it is very probable that this name will be retained.

Alces, Latin, an elk. Moose is from an Indian word, *moussce*, "the eater." Buffon calls the animal, the *Eland* or *Orignal*. The French Canadians also recognize it by the latter name.

The articles on the deer of British North America, in this Journal, will be compiled from DeKay's Natural History of New York.—Audubon & Bachman's Quadrupeds of North America,—Proceedings of the Academy of Natural Sciences of Philadelphia, and various other books and periodicals.

found in the unsettled portions of Canada, Nova Scotia, New Brunswick, and the north west territory. The superiority in size possessed by this great animal over all other deer, is not accompanied by a corresponding increase of beauty. All who have examined those usually to be seen in confinement at the cities of Montreal and Quebec, will acknowledge that the moose is not a remarkably good looking animal. A full grown moose is of the size of a large horse. The body and neck are both short and stout, and the latter is covered with a thick mane of strong hair. The legs are long and clumsy, the head enormously large and not gracefully pointed as in other deer, but somewhat resembles that of an immense roman-nosed horse. It is terminated over the mouth by a long flexible upper lip which forms a moveable snout, like a short blunt proboscis.

This peculiar shape of the head, its narrowness below the eyes, and greater size at the mouth, gives to the moose a very ungainly appearance. The nostrils are very long, and the eyes are small in proportion to the size of the animal, and somewhat deeply sunk into the head. The ears are about twelve inches in length, and the feet are cleft so far up that the hoofs separate widely in walking.

In winter the moose is covered with long coarse hair, and in summer with a short glossy coat. The colour is generally blackish, brown, or black, lighter under the belly, on the nose, and inside the ears. There is a long tuft, eight or ten inches in length, hanging down beneath the jaws in the young moose. Some of the individuals are of various shades of grey, and it is said that these are the largest, sometimes attaining the height of eight feet, and weighing 1500 lbs.

The gigantic horns of the moose are well known in almost every town of Europe or America where there is a museum. It is difficult to believe that those enormous solid appendages are the growth of a single season, and yet the fact is too well established to admit of a doubt. Only the males are provided with them, and no matter how large they may be, they grow to their full size in about twelve or fourteen weeks. On the young moose, one year old, they "are merely short knobs; they increase in size after each annual shedding, and after the fourth year become palmated, and may be termed full grown about the fifth year. The palms are, on the widest part, on a moderate sized male, about 11 inches wide. The space between the roots, six or seven inches. A very large pair measures over five feet between the tips, and will weigh 60 or 70 pounds. They begin to sprout in April, and fall off in December or January. It is said that their growth is complete in July, when the velvet peels off, and they are then white, but afterwards become brown or yellow. From one to three points or short prongs are added to the palms each year, so that the age of the animal is not indicated by the number of these prongs as is generally supposed.

In fighting with each other they use both horns and feet, but in contending with dogs, only the latter, with which they strike tremendous blows. Their pace is a long swinging trot, which they can keep up for several hours in succession.

The following interesting account of the habits of this famous deer is from Mr. James E. Powell, a hunter in Maine, and was read before the Philadelphia Academy of Natural Sciences, in June last :—

"In regard to the moose, I speak of it only as I am acquainted with it in this State (Maine), other latitudes causing some slight variation in its habits.

"When the snows have left the ground entirely bare, which, in the favorite haunts of the moose, happens about the middle of May, they leave their winter haunts and approach the marshes, ponds and rivers, where they come to search for their summer food, consisting of all the various aquatic plants which flourish in this region. Their favorite food, however, is the water lily and rush, in all their varieties, and at this season they crop them as soon as they appear, close to the bottom, frequently holding their heads under water a minute or eighty seconds, and often wading in water so deep, that when they put their heads down under the surface, to obtain the small lily leaves or to dig up the root of the plant (which they often eat at this season), before the leaves are plentiful, only a portion of the back is visible. About this time the females go apart, seeking the most impenetrable thickets that border on or near water, and there bring forth their young ; those of three years old and upwards almost invariably producing two. Still I have occasionally, but very rarely, seen and known three at a birth. Those of two years old never produce more than one. They shed their coats of long, rough hair, too, at this period, and are soon covered with short, smooth, fine hair, of a dark brown color, which, however, soon becomes a jetty, glossy black on the sides and back, and grey on the legs (with the exception of one variety of the animal, which is of a grey colour, and which is now very scarce here. As the season advances, the moose frequent the water still more, and remain in it longer at a time. In May, or early in June, they seldom stay in it more than half an hour at once, but in July and August they sometimes remain in the water several hours, and also frequent the waters very much during the night, especially in hot, dry, sultry weather, or thunder storms, which they seem particularly to delight in, swimming back and forth, apparently in a high state of enjoyment. During these visits to the water, the female secretes her young with great care, to protect them from the ferocity of the old males that would destroy them. For this purpose they commonly select a very dense clump of large bushes, or a spruce or fir thicket, which, from its density, prevents the male from reaching them, on account of his horns, which generally sprout in April. They grow rapidly, and are very tender and easily hurt at this time. By September the horns are out of the velvet, and have acquired hardness, and towards the close of this month the moose leaves the water for two or three weeks and resort to the mountains. At this period the males are frequently very fat, (I have killed them with nearly three inches in thickness of fat on the rump,) and are often very fierce and savage, sometimes even *attacking* the hunter, but in the course of a few weeks they become thin and poor, in consequence of their continual roaming and their many combats. They also neglect food at this time. At this period the loud bellow of the male is frequently heard and distinguished by the watchful hunter at the distance of two or three miles, in the stillness of night. The males also make another noise, which, from its peculiar sound, the hunters call chopping; it is produced by forcibly bringing together and separating the jaws in a peculiar and singular manner, and (as its name implies) resembles the sound of an axe, used at a great distance. They also emit a variety of strange sounds and cries. When they return to the water they spend a great deal of time in it for a week or two, but afterwards they gradually shorten their visits, until the sharp frosts set in. Still, they occasionally come into it, till ice forms an inch thick during the night. Then they leave and return to the mountains, where they select their fall and winter haunts, roaming about and subsisting on the bark of small trees, which they peel or gnaw off, and the twigs of the fir tree and other woods. When the deep snows fall, they select a spot well adapted to their wants, and commence to browse and peel more closely. This is called 'yarding,' and as the snow deepens and crusts form on its surface, they peel and break down bushes and browse closely, in preference to wallowing through the snow in search of choicer food. A 'moose yard' frequently occupies about one hundred acres, more or less, but the latter few weeks of the season is frequently spent on an area of ten acres, or less. The old males and females never 'yard' together, but sometimes the young animals are found occupying the same 'yard.' Still they are seldom found in close company. The females and their calves frequently yard together, the calves remaining with the mother one year. The oldest males invariably yard alone, choosing some lonely knoll or mountain peak, where they reside in utter solitude. Indeed, as age increases, the moose becomes more solitary in his habits, avoiding the common resorts of other moose, and frequenting some lone little pond or stream. The moose of two and three years old, also, often yards alone, but the males between the ages of three and ten years are very gregarious. I have known as many as nine in one yard. When hunted at this time (deep snow,) they go off in Indian file, each moose stepping accurately in the foot-prints of its predecessor, so that any but an experienced hunter would scarcely suppose that more than one moose had passed, when perhaps six or seven had gone in reality. Still, when they are closely pursued, and the one that is first becomes tired, (in consequence of having to break the way through the snow,) that one turns out a very little, and (the rest having past him) bring up the rear. So they change in rotation, the males showing the most chivalrous spirit in aiding the females or the weaker ones. Sometimes, too, they break their order of going in awkwardly passing a tree, when hard pressed, some going on each side, but instantly falling into line again when the obstacle is passed. At this season the 'spikehorn,' or two year old male, is noted as affording the longest and most difficult chase, and the oldest male for making the most gallant fight. In fact, they often refuse to run at all.

"A 'moose-yard' presents a strange sight to those not familiar with it, with its broken bushes and peeled trees; for sometimes, when the snow is very deep and difficult for them to get through, they break down and browse closely the tops of young fir trees five or six feet from the ground, and where they are two or three inches in diameter. They also reach up and peel and browse ten or twelve feet high above the ground, raising the fore legs and allowing the weight of the body to rest on the hind ones. Although so fond of browsing the fir, they never eat the bark of it, yet they seldom kill any other tree, as they generally peel only one side of those they use for food; they also break down the bushes in one direction, pulling them towards them; so that the direction the moose has taken is known to the hunter by this sign, when he first approaches a 'yard.' The young fir-trees are killed by the males rubbing their heads against them, instinct teaching them in that manner to apply the balsam of fir (which possesses great healing powers) to the sore and tender places caused by the loosening and falling off of the horns.

"The favorite winter food of the moose is the twigs of the fir tree and the bark of the mountain ash, and of a species of dwarf maple, and the young twigs of the 'moosewood.'

"During the summer the females are often seen accompanied by their two calves, but in the winter there is seldom more than one calf found with each female. From this I infer that the young of the moose are subject to many dangers. The female gives an abundance of milk, and the growth of the moose is very rapid for the first three years. It possesses immense strength and is capable of enduring long continued exertion and very great fatigue. It consumes very little food in proportion to its size, and, during the winter, seldom drinks, quenching its thirst with snow. Yet it very often chooses its yarding place near or on some little streamlet, perhaps on account of its favorite maple being most abundant in such places.

"The age of the moose is not great. I have never known but one to attain the age of twenty years; in fact, it is a rare and uncommon thing to find one that has attained the age of fifteen years. It possesses a quick ear and very strong, keen scent, and differs from most other wild animals in regard to its desire to attack a person bearing a torch, or rather the torch itself. For instance, in hunting on a dark night, in a canoe, on the water, when in pursuit of a deer, &c., a flambeau, or torch, or candle, can be used to great advantage, the animals being apparently bewildered or fascinated by the bright, steady light which approaches them so noiselessly and still; but the moose, as soon as he perceives it, approaches it, quickening his pace as he comes nearer, till (unless utterly disabled by the deadly rifle shot) he charges full upon it, destroying the canoe, and frequently injuring its occupant. However, with the extinction of the torch his fury ceases. The moose is easily tamed, and when domesticated, exhibits much sagacity, and has, if well treated, a very affectionate disposition. I kept a young one (one year old) a short time, which manifested as much docility and affection as a pet lamb. But when *insulted* or injured they are very revengeful and unforgiving. In reference to which I will relate an anecdote.

"The moose above alluded to was a great favorite with a young girl, who used to visit him several times a day, playing with him and giving him such delicacies as were most grateful to his epicurean palate (by the way, he acquired a strong predilection for boiled, mashed potatoes,) and the moose always showed the greatest pleasure when she was present. But one day, in a frolicksome mood, she bound some gaily colored ribbons in her hair, leaving the ends loose and fluttering, surmounting the whole by a tall and flaunting plume. Thus attired she slowly approached the moose, while we stood watching and wondering how he would recognise her. At length, gently and in perfect silence, she stood beside the moose, and he slowly and haughtily turned his head, surveying her strange appearance with the most ineffable contempt. At last, utterly unable to repress her mirth at the ridiculous scene, she gave way to a fit of loud joyous merriment. The wonted sound seemed to affect the moose, and he partially turned his head away, then took another survey of her strange appearance and his eyes suddenly lit up with a red savage, fiery light, and he struck her forcibly with his fore foot, and, had it not been for instant assistance, would probably have killed her. He never afterwards would permit her to approach him, showing signs of discontent and anger if she came within ten or twelve rods of him, and if (when at liberty in the field) he ever saw her he would instantly rush to attack her. Two or three times, when escaping into the house, she had not time to shut the door, and the revengeful beast followed her into the rooms, to the great detriment of the furniture. We have often heard of a bull in a crockery shop, but fancy a *moose* in a parlor. And if I was not present, no other person could eject him, but he would instantly come at my call and be obedient and submissive; and if at any time this strange creature fancied itself not sufficiently noticed or petted by me, it would utter most piteous cries until it attracted attention.

"The animal in a wild state is very lithe and supple, turning itself about and bending its form as easily as an ordinary dog, frequently standing in the most singular postures. It also frequently crawls on its knees, to pass under logs, &c., and drinks, in very shoal water, in the same position."

In feeding, they use their long upper lip to clasp the twigs and leaves. In peeling the branches and small saplings, they place the hard roof of the mouth upon one side and the teeth of the lower jaw upon the other, by which means they speedily strip off the bark.

The following account of the methods of hunting the Moose was written by Mr. Kendall, of Quebec, and published in Audubon and Bachman's Quadrupeds of North America:—

"The seasons for hunting the moose are March and September. In March, when the sun melts the snow on the surface and the nights are frosty, a *crust* is formed, which greatly impedes the animals progress, as it has to lift its feet perpendicularly out of the snow or cut the skin from its shanks by coming in contact with the icy surface.

"It would be useless to follow them when the snow is soft, as their great strength enables them to wade through it without any difficulty. If you wish to see them previous to shooting them in their "yard," it is necessary to make your approach to leeward, as their sense of smelling and hearing is very acute; the crack of a twig will start them, and they are seldom seen any more, until fatigue compels them to knock up, and thus ends the chase. Their pace is a long trot. It is necessary to have two or three small curs (the smaller the better), as they can run upon the snow without breaking through the crust; their principal use is to annoy the moose by barking and snapping at their heels, without taking hold. A large dog that would take hold would be instantly trampled to death. The males generally stop, if pressed, and fight with the dogs; this enables the hunter to come up unobserved and despatch them. Sometimes they are killed after a run of an hour, at other times you may run them all day, and have to camp at night without a morsel of provisions or a cloak, as everything is let go the moment the moose starts, and you are too much fatigued to retrace your steps to procure them. Your only resource is to make a huge fire, and comfort yourself upon the prospect of plenty of moose-meat next day. As soon as the animal finds he is no longer pursued, he lies down, and the next morning he will be too stiff to travel far. Generally, a male, female, and two fawns are found in a 'yard.'

"When obliged to run, the male goes first, breaking the way, the others treading exactly in his track, so that you would think only one has passed. Often they run through other 'yards,' when all join together, still going in Indian file. Sometimes, when meeting with an obstacle they cannot overcome, they are obliged to branch off for some distance and again unite; by connecting the different tracks at the place of separation you may judge pretty correctly of their number. I have seen twelve together, and killed seven of them.

"A method of hunting this animal is as follows:

"In September, two persons in a bark canoe paddle by moonlight along the shore of the lake, imitating the call of the male, which, jealous of the approach of a stranger, answers to the call and rushes down to the combat. The canoe is paddled by the man in the stern with the most death-like silence, gliding along under the shade of the forest until within short shooting distance, as it is difficult to take a sure aim by moonlight; the man in the bow generally fires, when if the animal is only wounded, he makes immediately for shore, dashing the water about him into foam; he is tracked by his blood the next day to where he has laid down, and where he is generally found unable to proceed any further. Many are killed in this manner in the neighbourhood of Moose River every season.

"Hunters sometimes find out the beaten tracks of the moose (generally leading to the water), and bend down a sapling and attach to it a strong hempen noose hanging across the path, while the tree is confined by another cord and a sort of trigger. Should the animal's head pass through the dangling snare, he generally makes a struggle which disengages the trigger, and the tree springing upward to its perpendicular, lifts the beast off his legs, and he is strangled!"

Sir John Richardson states that in the more northern part of North America the Moose is a very solitary animal, more than one seldom being seen at a time unless during the autumn. "It has the sense of hearing in very great perfection and is the most shy and wary of all the deer-species, and on this account the art of moose-hunting is looked upon as the greatest of an Indian's acquirements, particularly by the Crees, who take to themselves the credit of being able to instruct the hunters of every other tribe.—The skill of a moose-hunter is most tried in the early part of the winter; for during the summer the moose, as well as other animals, are so much tormented by musquitoes that they become regardless of the approach of man. In the winter the hunter tracks the moose by its foot-marks in the snow, and it is necessary that he should keep constantly to leeward of the chase and make his advances with the utmost caution, for the rustling of a withered leaf or the cracking of a rotten twig is sufficient to alarm the watchful beast. The difficulty of approach is increased by a habit which the moose-deer has of making daily a sharp turn in its route, and choosing a place of repose so near some part of its path that it can hear the least noise made by one that attempts to track it. To avoid this the judicious hunter, instead of walking in the animal's footsteps, forms his judgment from the appearance of the country of the direction it is likely to have taken, and makes a circuit to leeward until he again finds the track. This manœuvre is repeated until he discovers, by the softness of the snow in the foot-marks and other signs, that he is very near the chase. He then disencumbers himself of everything that might embarrass his motions, and makes his approach in the most cautious manner. If he gets close to the animal's lair without being seen, it is usual for him to break a small twig, which alarming the moose, it instantly starts up, but not fully aware of the danger squats on its hams and voids its urine preparatory to setting off. In this posture it presents the fairest mark, and the hunter's shot seldom fails to take effect in a mortal part. In the autumn the bucks lay aside their timidity, and attack every animal that comes in their way, and even conquer their fear of man himself. The hunters then bring them within gun-shot by scraping on the blade-bone of a deer and by whistling, which, deceiving the male, he blindly hastens to the spot to assail his supposed rival. If the hunter fails in giving it a mortal wound as it approaches, he shelters himself from its fury behind a tree, and I have heard of several instances in which the enraged animal has completely stripped the bark from the trunk of a large tree by striking with its fore feet.

"The flesh of the moose is very good, though the grain is coarse, and it is much tougher than any other kind of venison. The nose is most excellent, and as is also the tongue, but by no means so fat and delicate as that of the common deer (caribou.) The fat of the intestines is hard, like suet; but all the external fat is soft, like that of a breast of mutton, and when put into a bladder is as fine as marrow. In this they differ from all the other species of the deer, of which the external fat is as hard as that of the kidnies."

The skin of the moose deer, when properly dressed, makes very good moccassins, mittens, leggins, and other articles useful in a cold climate

The question whether the moose is precisely the same species as the elk of Europe, does not appear to be yet decided. The general rule, with respect to the quadrupeds of America, seems to be, that, no matter how much they may at first sight resemble those of the old world, yet, when a close comparison is instituted, they are found to be different. Thus the red fox, the wolf, and the stag (*Elaphus Canadensis*) were all regarded by the earlier emigrants as identical with those upon the other side of the Atlantic, but they are now known to be sufficiently different to constitute distinct species. It is thus with the moose and the elk. The size, habits, food and movements appear to be the same. In Lloyd's Field Sports of the North of Europe, he states that the female elk brings forth, about the middle of May, from one to three young ones ; but it is seldom that she has more than two. At this period, the mother retires alone to the wildest recesses of the forest, After a lapse of two or three days, the fawns, which are of a light brown colour, have sufficient strength to follow their dam everywhere ; they keep with her until they are in their third year, when she leaves them to shift for themselves.

"The elk is a long-lived animal ; he does not attain to his full growth until after his fourteenth year. At least so it is to be presumed, as up to that period his horns, which are of a flat form, are annually provided with an additional branch. He sheds his horns about the month of February in each year. The female elk, unlike the rein-deer of that sex, has no horns. The horns of the young male elk are perceptible nine months after its birth ; for the first year they are cylindrical and short ; the second year they are about a foot in length, but not branched ; the third year two points are discernible ; the fourth year three ; the fifth year they are full grown in length. From that time forward they yearly increase in breadth and in the number of branches until there are as many as fourteen on each horn.

"By nature the elk is timorous, and he usually flies at the sight of man. In the autumn, however, like other animals of the deer kind, he is at times rather dangerous. His weapons are his horns and hoofs ; he strikes so forcibly with the latter as to annihilate a wolf or other large animal at a single blow. It is said that when the elk is incensed, the hair on his neck bristles up like the mane of a lion, which gives him a wild and frightful appearance.

"The usual pace of the elk is a high shambling trot, and his strides are immense, but I have known him when frightened to go at a tremendous gallop. In passing through thick woods he carries his horns horizontally, to prevent them being entangled in the branches. From the formation of his hoofs he makes a great clattering, like the rein-deer when in rapid motion. In the summer season the elk usually resorts to morasses and low situations ; for, like other animals of the deer kind, he frequently takes to the water in warm weather ; he is an admirable swimmer. In the winter time he retires to the more sheltered parts of the forest, where willow, ash, &c., are to be found ; as from the small boughs of these trees he obtains his sustenance during that period of the year. In the summer and autumn the elk is often to be met with in small herds, but in the winter there are seldom more than two or three in company. At the latter season indeed he is frequently alone.

"The flesh of the elk, whether fresh or smoked, is very excellent; the young are particularly delicious. According to Mr. Nilsson it resembles in taste that of the stag. The tongue and the nose are thought to be great delicacies in Scandinavia as well as in America. Great virtue was once placed in the hoof of that animal, as parings of it were supposed to be a specific against the falling sickness and other disorders; but this idle notion must by this time, I should think, be nearly exploded. The skin is convertible to many purposes, and is very valuable. Mr. Greiff says:—'It is not long since that a regiment was clothed with waistcoats made from the hides of those animals, which were so thick that a ball could scarcely penetrate them.' He adds further, that 'when made into breeches, a pair of them among the peasantry of former days went as a legacy for several generations.'

"The elk is easily domesticated; several instances have come to my knowledge. I had a fawn in my own possession a year ago, but from want of proper nourishment it died. Formerly these animals were made use of in Sweden to draw sledges, but owing, as it was said, to their speed frequently accelerating the escape of people who had been guilty of murders, or other crimes, the use of them was prohibited under great penalties. Though I apprehend those ordinances if not abrogated are obsolete, I am not aware that the elk is ever made use of in that kingdom at the present day, either to draw a sledge or for other domestic purposes.

"In Sweden, as I have observed, it is contrary to law at this particular time to kill the elk at any season of the year; this is not the case in Norway; for in that country as I have just shown, these animals may be destroyed with certain limitations as to numbers, from the 1st of July to the 1st of November inclusive. The penalty, however, for killing an elk out of season in Norway is very much heavier than in Sweden; it amounts indeed, including legal expenses, &c., to about £20, which is no inconsiderable sum in that kingdom."

From the above extract, it will be seen how very similar the European elk must be to the American moose deer. We do not pretend to be any authority in the matter, never having seen the elk of the old world, although we have often admired the stately dimensions of that of the new.

Geographical Distribution.

The Moose is found in Nova Scotia, New Brunswick, Maine, and Labrador. In Lower Canada on both sides of the St. Lawrence below Quebec, and west of Quebec, on the north shores of the St. Lawrence and Ottawa, to Lake Temiscamangue. It rarely strays over to the South shore of the Ottawa, but they are sometimes killed on that side of the river. In the northwest they range to the mouth of Mackenzie's River, on the Arctic sea in latitude 69°. In the State of New York they still exist—rarely in Herkimer, Franklin, Lewis, and Warren counties.

ARTICLE VIII.—*The Northern Reindeer, or Barren Ground Caribou, (Tarandus arcticus.)*

GENUS TARANDUS.

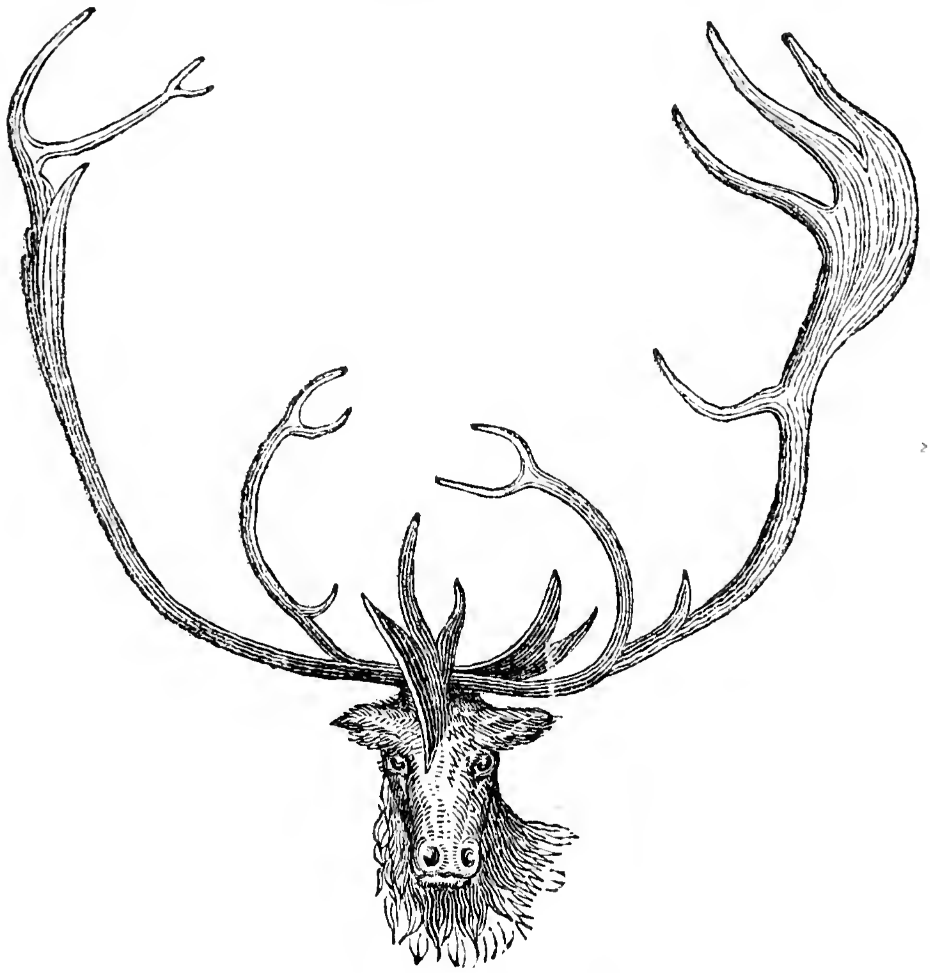
DENTAL FORMULA.

Incisive $\frac{0}{8}$; *Canine* $\frac{1\text{-}1}{0\text{-}0}$; *Molar* $\frac{6\text{-}6}{6\text{-}6}$—34.

Horns in both sexes, Canine teeth in both sexes, muzzle small, horns slender, smooth, palmated, lachrymal sinus.

TARANDUS ARCTICUS, (Richardson.)

Smaller than the common deer, ***Cervus virginianus***, general colour clove brown in summer, whitish in winter. Inhabits the " Barren grounds" and Arctic regions of North America.



Head of Tarandus arcticus,—Front view.

There are two species of Reindeer, commonly called Caribou, in North America, confined in their geographical distribution to the eastern and northern portions of the continent. One of these, the subject of the present

NOTE.—The Reindeer have eight incisors or front teeth in the lower jaw, and twelve molar or grinding teeth, six on each side. In the upper jaw they have no incisors, but two small canine teeth and twelve molars, six of the latter and one of the former on each side. The above figures represent the numbers, the upper row standing in the place of the upper jaw, and the lower row the lower jaw.

" *Tarandus*," a Reindeer; *Arcticus*, latin; " Arctic." In the Natural History of New York this animal is called *Rangifer tarandus;* in Audubon and Bachman's Quadrupeds of North America, *Rangifer Caribou;* by many authors, *Cervus tarandus;* by the Cree Indians, *Attehk;* by the Chippewyans, *Etthin;* Esquimaux, *Tooktoo;* Greenlanders, *Tukta;* French Canadians, *Carre-bœuf* or *Caribou*, literally a " *square ox.*"

article, is very abundant in the summer season, in a tract of barren, treeless country, bounded on the south by the Churchill river ; on the west by the Great Slave, Athabasca, Wollaston, and Deer Lakes, and the Coppermine rivers ; while towards the north it stretches away quite to the Polar seas. It is from the circumstance of its being the only deer found in this desolate region, that the Barren Ground Caribou has received this one of its names. The animal, however, is not strictly confined to that territory, for in the autumn it migrates towards the south, and spends the winter in the woods, and again towards the northwest it ranges nearly across the continent.

This is the deer so frequently mentioned by the hardy adventurers in search of the north-west passage ; the other reindeer is the caribou of Lower Canada, New Brunswick, and Nova Scotia. It shall receive some attention in the next article.

Head of Tarandus arcticus,—Side view.

From the accounts furnished by the many travellers who have visited the Barren Grounds, *Tarandus arcticus* is a small deer, the largest and fattest bucks weighing only from 90 to 120 lbs., exclusive of the offal. Its legs are shorter and stouter in proportion to its size than those of the common deer, and the front part of the head more blunt like that of a cow. The horns are slender and palmated at their upper extremities, and near their base they send out brow antlers, which incline downwards in front of the forehead, and are flattened laterally, so that the palmated portion is vertical before and between the eyes. Both males and females have horns, and they fall off and are renewed annually, as in other deer. The ears are small, oval and covered both inside and out with thick hair ; the feet are very broad, flat, concave beneath, and adapted for digging in the snow. The tail is of moderate length, the hair in winter being long and coarse, in summer short and smooth. The general colour is greyish brown, with the belly, insides of legs, and under part of the neck white. The caribou is a true reindeer, and in the descriptions given by various authors, it is usually spoken of as so closely allied to the European species *Tarandus furcifer*, that the two cannot be well separated. The more recent works, however, shew that not only are the American reindeer distinct from those of the old world, but that upon this continent we have two species which differ greatly in their size—occupy different regions, and when they meet on common ground do not commingle or associate with each other. The species of the two continents are the representatives of each other, or the one occupies the same place in the general economy of nature in one part of tbe world that the other does in another quarter, and yet they are distinct species.

Sir John Richardson, the celebrated explorer of the northern portion of America, says, in his work upon the animals of the country .—

"In the month of July, the Caribou sheds its winter covering, and acquires a short coat of hair, of a colour composed of clove brown, mingled with deep reddish and yellowish-brown, the under surface of the neck, the belly, and the inner sides of the extremities, remaining white in all seasons. The hair at first is fine and flexible, but as it lengthens it increases gradually in diameter at its roots, becoming at the same time white, soft, compressible, and brittle, like the hair of the moose deer. In the course of the winter the thickness of the hairs at their roots becomes so great that they are exceedingly close, and no longer lie down smoothly, but stand erect, and they are then so soft and tender below, that the flexible coloured points are easily rubbed off, and the fur appears white, especially on the flanks. This occurs in a smaller degree on the back; and on the under parts, the hair, although it acquires length, remains more flexible and slender at its roots, and is consequently not so subject to break. Towards the spring, when the Deer are tormented by the larvæ of the gad-fly making their way through the skin, they rub themselves against stones and rocks until all the colored tops of the hair are worn off, and their fur appears to be entirely of a soiled white colour.

"The closeness of the hair of the Caribou, and the lightness of its skin, when properly dressed, render it the most appropriate article for winter clothing in the high latitudes. The skins of the young Deer make the best dresses, and they should be killed for that purpose in the month of August or September, as after the latter date the hair becomes too long and brittle. The prime parts of eight or ten Deer-skins make a complete suit of clothing for a grown person, which is so impervious to the cold that, with the addition of a blanket of the same material, any one so clothed may bivouack on the snow with safety, and even with comfort, in the most intense cold of an Arctic winter's night.

"The Barren ground Caribou, which resort to the coast of the Arctic sea in summer, retire in winter to the woods lying between the sixty-third and the sixty-sixth degree of latitude, where they feed on the long grass of the swamps. About the end of April, when the partial melting of the snow has softened the *cetrariæ, cornicularïæ*, and *cevomyces*, which clothe the barren grounds like a carpet, they make short excursions from the woods, but return to them when the weather is frosty. In May the females proceed towards the sea-coast, and towards the end of June the males are in full march in the same direction. At that period the power of the sun has dried up the lichens on the barren grounds, and the Caribou frequent the moist pastures which cover the bottoms of the narrow valleys on the coasts and islands of the Arctic sea, where they graze on the sprouting carices and on the withered grass or hay of the preceding year, which is at that period still standing, and retaining part of its sap. Their spring journey is performed partly on the snow, and partly after the snow has disappeared, on the ice covering the rivers and lakes, which have in general a northerly direction. Soon after their arrival on the coast the females drop their young; they commence their return to the south in September, and reach the vicinity of the woods towards the end of October, where they are joined by the males. This journey takes place after the snow has fallen, and they scrape it away with their feet to procure the lichens, which are then tender and pulpy, being preserved moist and unfrozen by the heat still remaining in the earth. Except in the autumn, the bulk of the males and females live separately; the former retire deeper into the woods in winter, whilst herds of the pregnant does stay on the skirts of the barren grounds, and proceed to the coast very early in spring. Captain Parry saw Deer on Melville peninsula as late as the 23d of September, and the females, with their fawns, made their first appearance on the 22d of April, The males in general do not go so far north as the females. On the coast of Hudson's Bay the Barren-ground Caribou migrate farther south than those on the Coppermine or Mackenzie rivers; but none of them go to the southward of the Churchill.

"When in condition, there is a layer of fat deposited on the back and rump of the males to the depth of two or three inches or more, immediately under the skin, which is termed *depouillé* by the Canadian voyagers, and as an article of Indian trade, is often of more value than all the remainder of the carcass. The *depouillé* is thickest at the commencement of the autumn; it then becomes of a red colour, and acquires a high flavour, and soon afterwards disappears. The females at that period are lean, but in the course of the winter they acquire a small *depouillé*, which is exhausted soon after they drop their young. The flesh of the Caribou is very tender, and its flavor when in season is, in my opinion, superior to that of the finest English venison, but when the animal is lean it is very insipid, the difference being greater between well fed and lean Caribou than any one can conceive who has not had an opportunity of judging. The lean meat fills the stomach but never satisfies the appetite, and scarcely serves to recruit the strength when exhausted by labour." 'The Chepewayans, the Copper Indians, the Dog-Ribs and Hare Indians of Great Bear Lake, would be totally unable to inhabit their barren lands were it nor for the immense herds of this Deer that exist there. Of the Caribou horns they form their fish-spears and hooks; and previous to the introduction of European iron, ice chisels and various other utensils were likewise made of them.' The hunter breaks the leg-bones of a recently slaughtered Deer, and while the marrow is still warm, devours it with relish. The kidneys, and part of the intestines, particularly the thin folds of the third stomach or manyplies, are likewise occasionally eaten when raw, and the summits of the antlers, as long as they are soft, are also delicacies in a raw state. The colon or large gut is inverted, so as to preserve its fatty appendages, and is, when either roasted or boiled, one of the richest and most savoury morsels the country affords, either to the native or white resident, The remainder of the intestines, after being cleaned, are hung in the smoke for a few days, and then broiled. The stomach and its contents, termed by the Esquimaux *nerrooks*, and by the Greenlanders *nerrikak nerriookak*, are also eaten, and it would appear that the lichens and other vegetable matters on which the caribou feeds are more easily digested by the human stomach when they have been mixed with the salivary and gastric juices of a ruminating animal. Many of the Indians and Canadian voyagers prefer this savoury mixture after it has undergone a degree of fermentation, or lain to season, as they term it, for a few days. The blood, if mixed in proper proportion with a strong decoction of fat meat, forms, after some nicety in the cooking, a rich soup, which is very palatable and highly nutritious, but very difficult of digestion. When all the soft parts of the animal are consumed, the bones are pounded small, and a large quantity of marrow is extracted from them by boiling. This is used in making the better kinds of the mixture of dried meat and fat, which is named *pemmican*, and it is also preserved by the young men and women for anointing the hair and greasing the face on dress occasions. The tongue roasted, when fresh or when half dried, is a delicious morsel. When it is necessary to preserve the caribou meat for use at a future period, it is cut into thin slices and dried over the smoke of a slow fire, and then pounded betwixt two stones. This pounded meat is very dry and husky if eaten alone, but when a quantity of the black-fat or *depouillè* of the deer is added to it, is one of the greatest treats that can be offered to a resident in the fur countries.

"The caribou travel in herds, varying in number from eight or ten to two or three hundred, and their daily excursions are generally towards the quarter whence the wind blows. The Indians kill them with the bow and arrow or gun, take them in snares, or spear them in crossing rivers or lakes. The Esquimaux also take them in traps ingeniously formed of ice or snow. Of all the deer of North America they are the most easy of approach, and are slaughtered in the greatest numbers. A single family of Indians will sometimes destroy two or three hundred in a few weeks, and in many cases they are killed for their tongues alone"

This deer is described as of an unsuspecting but inquisitive disposition, the latter quality often leading to his destruction. The northern hunter, when he sees a caribou feeding in the open plain, approaches as near as he can without being secen, then throws himself upon the ground, draws his coat of skins over his head, and arranges it so as to resemble somewhat the form of a deer. He then attracts the animals attention by a loud bellow. Urged on by his curiosity, the silly caribou approaches to examine the mysterious object, capering about and running round in circles. Meanwhile the Indian remains perfectly still, well knowing that his prey will not be satisfied until he can get a near view, When within a short distance, twelve or twenty yards, the hunter shoots him with an arrow. Many of the northern Indians are still without guns, but they use their rude bows and arrows with great effect.

The Esquimaux digs a pit in the snow, and heaps up its sides, so that from a distance it rsembles a small rounded hillock. Within, the walls of the pit are perpendicular, and its mouth above is covered with a slab of ice, so arranged that when the deer walks over it, one end tips down suddenly, and having precipitated the deer into the pit, turns back and closes the entrance. For this purpose it is contrived with an axle running through it, and it appears from this account, if it be true, that the ice and snow of the north, owing to the intensity of the cold, is more solid and tough than it is in our country.

The Indians also construct large inclosures of brushwrod, sometimes a mile in circumference, with a narrow entrance, situated upon one of the more frequented paths of the deer. Within they have a multitude of winding lanes, formed of similar materials. In these they place a great many snares, made of deer-skin thongs of great strength, and then by various expedients manage to drive a herd of the deer into the enclosure. The terrified animals run about in all directions through the winding avenues, become entangled in the snares, and soon the whole herd is killed. Great numbers, it is said, are slain in this way, and some families are so successful that they do not require to remove their tents more than two or three times in a season.

The barren ground caribou spends the winter in the woodland regions, subsisting upon mosses and shrubs, and in the summer regularly migrates towards the north and the sea coast, and returns again to the south in the autumn.

Geographical Distribution.

From all the information we have been able to collect upon the subject, *Tarandus arcticus* never travels as far south as Canada, although its near relative, the woodland caribou, is abundant in certain parts of the Province.

Audubon and Bachman state that from the "Barren Grounds," it ranges westward across the continent, and that it is mentioned by several authors as inhabiting the Fox or Aleutian Islands. "It is not found so far to the southward on the Pacific as on the Atlantic coast, and is not found on the Rocky Mountains within the limits of the United States." In every part of Arctic America including the region from Hudson's Bay to far within in the Arctic circle, the Barren Ground Caribou is met with in greater or less abundance.

ARTICLE IX.—*The Woodland Caribou, (Tarandus hastalis.)*

TARANDUS HASTALIS, (Agassiz.)

Similar to ***Tarandus Arcticus***, but twice as large, horns more stout and short in proportion; inhabits Labrador and northern Canada, and thence south to Nova Scotia.

The species of Caribou, of which an account has been given in the last article, is a small animal, but the one now to be examined grows to a size much greater than that of the common red deer. A full grown and large woodland Caribou weighs 300 lbs., while it is rare to meet with a buck of the common species which would weigh 200. In fact, the woodland Caribou appears to be upon an average nearly twice the size of the common red deer. Its geographical range extends over Newfoundland, Nova Scotia, New Brunswick, the northern part of the State of Maine, Lower Canada upon both sides of the mouth of the St. Lawrence, thence westerly in the inhabited country north of Quebec to the rear of Lake Superior. It never migrates towards the north in the summer as is the habit of ***Tarandus arcticus***, but rather to the south; the lines of migration in the two species being in exactly opposite directions. In the Lower Provinces and in Labrador, it is somewhat abundant in the more secluded tracts of forest, and being more gregarious in its habits does not linger in the settlements like the common deer. The principal difference in form between this species and the last appears to consist in its superior size. The following is the description given by AUDUBON and BACHMAN of an individual two years and a half old:—"Larger and less graceful than the common American deer, body stout and heavy, neck stout, hoofs thin, flattened, broad and spreading, excavated or concave beneath, accessary hoofs, large and thin, legs stout, no glandular opening, and scarcely a perceptible inner tuft on the hind legs, nose somewhat like those of a cow, but fully covered with soft hairs of a moderate length, no beard but on the under side of the neck a line of hairs about four inches in length which hang down in a longitudinal direction, ears small, short and oval, thickly clothed with hair on both surfaces, horns one foot three and a half inches in height, slender, one with two and the other with one prong, prongs about five inches long, hair soft and wooly underneath the longer hairs like those of the antelope, crimped or waved, and about one to one and a half inches long." As to the colour of the animal, the authors state that "at the roots the hairs are whitish, then become brownish-grey, and at the tips are light dun grey, whiter on the neck than elsewhere, nose, ears, outer surface of legs, and shoulder brownish, a slight shade of the same tinge behind the fore legs, hoofs black, neck and throat dull white, a faint whitish patch on the sides of the shoulders, forehead brownish white, belly white, tail white with a slight shade of brown at the root and on the whole upper surface, outside of legs brown, a band of white around all the legs adjoining the hoofs and extending to the small secondary hoofs, horns yellowish brown, worn white in places."

The dimensions of this specimen were as follows:—Length from nose to root of tail, 6 feet; length of tail, 4 inches; height of shoulder, 3 feet 6 inches; width between the eyes, 5½ inches; length from point of nose to lower canthus of eye, 9 inches; from point of nose to the ear, 1 foot 2 inches; height of ear, 5 inches."

The height of a full grown animal of this species is four feet and a half, and the weight of its carcass, without the entrails, 300 pounds. It appears to be an exceedingly shy animal, seldom frequenting the fields, but confining itself to the swamps or marshy plains in the winter, where there is an abundance of moss and small shrubs upon which it feeds, "The caribou," says a writer in the same work, "is famous for its swiftness, and has various gaits, walking, trotting or gallopping alike gracefully and and rapidly. By many people these animals are, in fact, thought to be much fleeter than the moose, and they are said to take extraordinary leaps.

When pursued, the caribou immediately makes for a swamp, and follows the margin, taking at times to the water and again footing it over the firm ground, and sometimes turning towards the nearest mountain, crosses it by another morass. If hard pressed by the hunters, (who now and then follow up the chase for four or five days) the animal ascends to the highest peaks of the mountains for security, and the pursuit becomes very fatiguing and uncertain. Upon one occasion, two men followed several caribou for a whole week, when, completely tired out, they gave up the chase, which was then continued by two other hunters, who at last succeeded in killing a couple of the animals at long shot. Sometimes, however, fresh tracks are found, and the caribou is surprised whilst lying down or browsing, and shot on the spot. When the snow is not deep. and the lakes are covered with ice only, the animal, if closely pursued, makes for one of them and runs over the ice so fast that it is unable to stop if struck with alarm at any object presenting itself in front, and it then suddenly squats down on its haunches and slides along in that ludicrous position until the impetus being exhausted, it rises again and makes off in some other direction. When the caribou takes to the ice the hunter always gives up the chase. Sometimes, when the mouth and throat of a fresh killed caribou are examined, they are found to be filled with a blackish looking mucus, resembling thin mud, but which appears to be only a portion of the partially decomposed black mosses upon which it fed, probably forced into the throat and mouth of the animal in its dying agonies.

"When overtaken in the chase, the caribou stands at bay, and shows fight, and when thus brought to a stand still will not pay much attention to the hunters, so that he can approach and shoot them with ease."

If we are to believe what is stated of the speed and powers of endurance of the European reindeer, to which the caribou is so closely allied that naturalists were long in doubt as to the propriety of separating it as a distinct species, then it is easy to understand that the hunting of this animal must be a laborious undertaking. Journies of one hundred and fifty miles in twenty hours art said to be a common performance of the domesticated reindeer, and in 1690, one animal is affirmed to have drawn an officer, with important despatches, eight hundred miles in forty-eight hours.

In Forester's Game in its season, the author gives a very lively description of the Caribou, having reference to this species. He states that "as regards the nature of the pelage, or fur, for it is almost such, of the Caribou, so far from its being remarkable for closeness and compactness, it is by all odds the loosest and longest haired of any deer I ever saw; being, particularly about the head and neck, so shaggy as to appear almost maned.

"In color, it is the most grizzly of deer, and though comparatively dark brown on the back, the hide is generally speaking, light, almost dun-colored, and on the head and neck fulvous, or tawny gray, largely mixed with white hairs.

"The flesh is said to be delicious; and the leather made by the Indians from its skin, by their peculiar process, is of unsurpassed excellence for leggins, moccasins or the like; especially for the moccasin to be used under snow-shoes.

"As to its habits, while the Lapland or Siberian Reindeer is the tamest and most docile of its genus, the American Caribou is the fiercest, fleetest, wildest, shyest, and most untameable. So much so, that they are rarely pursued by white hunters, or shot by them, except through casual good fortune; Indians alone having the patience and instinctive craft, which enables them to crawl on them unseen, unsmelt—for the nose of the Caribou can detect the smallest taint upon the air of anything human at least two miles up wind of him—and unsuspected. If he takes alarm and starts off on the run, no one dreams of pursuing. As well pursue the wind, of which no man knoweth whence it cometh or whether it goeth. Snow-shoes against him alone avail little, for propped up on the broad, natural snow-shoes of his long, elastic pasterns and wide cleft clacking hoofs, he shoots over the crust of the deepest drifts, unbroken; in which the lordly moose would soon flounder, shoulder deep, if hard pressed, and the graceful deer would fall despairing, and bleat in vain for mercy—but he, the ship of the winter wilderness, outspeeds the wind among his native pines and tamaracks—even as the desert ship, the dromedary, out-trots the red simoon on the terrible Zahara—and once started, may be seen no more by human eyes, nor run down by fleetest feet of man, no, not if they pursue him from their nightly-casual camps, unwearied, following his trail by the day, by the week, by the month, till a fresh snow effaces his tracks, and leaves the hunter at the last, as he was at the first of the chase; less only the fatigue, the disappointment' and the folly.

Therefore, by woodsmen, whether white or red skinned, he is followed only on those rare occasions when snows of unusual depth are crusted over to the very point at which they will not quite support this fleet and powerful stag. Then the toil is too great even for his vast endurance, and he can be run down by the speed of men, inured to the sport, and to the hardships of the wilderness, but by them only. Indians by hundreds in the provinces, and many loggers and hunters in the Eastern States, can take and keep his trail in suitable weather—the best time is the latter end of February or the beginning of March ; the best weather is when a light, fresh snow of some three or four inches has fallen on the top of deep drifts and a solid crust; the fresh snow giving the means of following the trail; the firm crust yielding a support to the broad snow-shoes and enabling the stalkers to trail with silence and celerity combined. Then they crawl onward, breathless and voiceless, up wind always, following the foot prints of the wandering, pasturing, wantoning deer ; judging by signs, unmistaken to the veteran hunter, undistinguishable to the novice, of the distance or proximity of their game, until they steal upon the herd unsuspected, and either finish the day with a sure shot and a triumphant whoop ; or discover that the game has taken alarm and started on the jump, and so give it up in despair.

"One man perhaps in a thousand can still-hunt, or stalk, Caribou in the summer season. He, when he has discovered a herd feeding up wind, at a leisure pace and clearly unalarmed, stations a comrade in close ambush, well down wind and to leeward of their upward track, and then himself, after closely observing their mood, motions and line of course, strikes off in a wide circle well to leeward, until he has got a mile or two ahead of the herd, when very slowly and guardedly, observing the profoundest silence, he cuts across their direction, and gives them his wind, as it is technically termed, dead ahead. This is the crisis of the affair; if he gives the wind too strongly, or too rashly, if he makes the slightest noise or motion, they scatter in an instant, and away. If he give it slightly, gradually, and casually as it were, not fancying themselves pursued, but merely approached, they merely turn away from it, working their way *down wind* to the deadly ambush, of which their keenest scent cannot, under such circumstances, inform them. If he succeed in this, inch by inch he crawls after them, never pressing them, or drawing in upon them, but preserving the same distance still, still giving them the same wind as at the first, so that he creates no panic or confusion, until at length, when close upon the hidden peril, his sudden whoop sends them headlong down the deceitful breeze upon the treacherous rifle.

"Of all wood-craft, none is so difficult, none requires so rare a combination as this, of quickness of sight, wariness of tread, very instinct of the craft, and perfection of judgment. When resorted to, and performed to the admiration even of woodmen, it does not succeed once in a hundred times—therefore not by one man in a thousand is it ever resorted to at all, and by him, rather in the wantonness of wood-craft, and by way of boastful experiment, than with any hope, much less expectation of success."

Professor Dawson on new species of *Meriones*.—In the last January number of the Edinburgh New Philosophical Journal, there is an interesting article on the *Meriones* and *Arvicola* of Nova Scotia, by Professor Dawson, of McGill College, Montreal. The learned Professor describes and figures a new species of "Jumping Mouse," *Meriones Acadicus.*

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ARTICLE X.—*On the Wapite, or Canadian Stag, (Elaphus Canadensis)*

GENUS ELAPHUS.

The males of this genus have large, round, branching horns, and canine teeth in the upper jaw only. The females have neither horns nor canine teeth. Both sexes have the head terminating anteriorly in a muzzle. They have also a lachrymal or sub-orbital sinus. The Dental Formula is as follows :—*Incisive*, $\frac{0}{8}$; *Canine*, $\frac{1-1}{0-0}$; *Molar*, $\frac{6-6}{6-6}$;—34. The generic name is derived from the Greek *Elaphos*, a stag. The red deer of Britain is a species of this genus. The only species known in America is the Wapite or Canadian Stag, commonly called the *American Elk*.

ELAPHUS CANADENSIS.

SPECIFIC CHARACTERS.—*Larger than the Common Deer ; Horns large, not palmated, with brown antlers ; a naked space round the lachrymal opening ; tail short ; Colour yellowish, brown above, a black mark extending from the angle of the mouth along the sides of the lower jaw ; a long pale yellowish spot on the buttocks.*

According to tradition, one hundred and twenty years ago, this deer was not uncommon north of the St. Lawrence, and upon the arrival of the first white settlers its range extended over the whole of the United States. At present it is abundant in the western prairies and the eastern side of the Rocky

Mountains, from the 56th or 57th parallel of north latitude to Texas, In the Hudson's Bay Territories, according to Sir John Richardson, its eastern limit is a line drawn from the south end of Lake Winnipeg to the Saskatchewan, in the 103rd degree of longitude, thence till it strikes the Elk River in the 111th degree. It is found rarely on the Alleghany mountains.

In Eastern Canada it is only known by the horns and scattered bones that are now and then discovered by the pioneers of the forest, while clearing up the land, and it may, therefore, so far as this section of the country is concerned, be looked upon as an extinct species.

It is a large and elegant animal, so much resembling the stag of Europe that, by the first white explorers of the continent, it was thought to be the same. Being, however, much larger and different in its colour, habits, and other particulars, it has long since been decided by competent naturalists to be distinct. It is between four feet six inches and five feet high at the shoulders, or about one foot higher than the English stag. In Knight's Cyclopædia of Natural History, it is said that "all the upper parts and the lower jaw are of a somewhat lively, yellowish brown; there is a black mark from the angle of the mouth along the side of the lower jaw, and a brown circle around the eye. The neck is mixed with red and black, with coarse hair descending from it like a dew-lap, deeper in colour than the sides.—From the shoulders to the hips, French gray; a pale yellowish patch on the buttocks, bounded on the thighs by a black line. The tail is yellowish, and only 2½ inches long, whereas it is nearly 7 inches in the European stag.—The hair is of a mean length on the shoulders, the back the flanks, the thighs, and the under part of the head; that on the sides and limbs is shorter, but the hair is very long on the sides of the head, posteriorly, and on the neck, particularly below where it forms the kind of dew-lap above alluded to. On the posterior and outer aspects of the hind legs, there is a brush of tawny hair which surrounds a narrow long horny substance. The ears are white within, and clothed with tufted hair externally of the same colour as the neighbouring parts; a naked triangular space round the large lachrymal sinus near the inner angle of the eye; hoofs small and black, like the common stag. The Wapite has a muzzle, upper canine teeth, and a soft tongue; the quality of the hair is brittle, and there is a short wool beneath it.*

The horns are round, very large and long. A fragment now lying before us which was found in the County of Renfrew, is two feet four inches in length and seven inches in circumference. It is a piece from the central part of a horn that was probably over four feet in length when perfect. A pair of horns from the head of a full grown Wapite weigh from thirty-five to forty-five pounds. We have just weighed a pretty large pair of buck's horns of the common species, (*Cervus Virginianus,*) and find their weight to be four and a half pounds. Those of the Wapite are therefore on an average, ten times the size of those of the common buck. They are not curved forward, but rise from the head upward and backward, the main shaft being nearly on a straight line with the facial outline, or a line drawn from the point of the nose above to the forehead. Near the base they sometimes have brow antlers, or branches which bend downward. Fragments of these enormous horns are frequently found in the new Townships of Canada by the settlers, while clearing their land from the forest. They may be easily distinguished from the horns of the moose by their not being palmated, but round, with round sharp prongs; and on account of their great size, they can never be mistaken for those of the common deer. Within the last one hundred and twenty years the Wapite was somewhat common in the valley of the Ottawa, according to traditions among the Indians. The many fragments of horns we have seen, do not appear to have lain in the ground more than one hundred years. They are usually found in the vegetable soil just beneath the

* **English Cyclopædia of Natural History, vol. 1, page 855.**

layer of decomposing leaves or moss, that everywhere in the woods forms the surface. While excavating the Rideau Canal about twenty-five years since the perfect skeleton of a Wapite was exhumed at the Hogs-back, near the site of the present City of Ottawa. The horns were attached to the skull, and five feet long. Three years since the skeleton of a large deer was discovered in the County of Lanark, which was probably of this species.

The Wapite is still somewhat abundant in the Western praries. In the paper from which our engraving of the animal is taken, Professor Baird says :—"The American Elk, sometimes called Wapite, was once extensively distributed throughout the present limits of the United States. At the present time, in the eastern parts, it is only found in a few counties of Pennsylvania—as Elk and Clearfield—where, indeed, their numbers are decreasing day by day. Occasionally one has been seen in the Moose range of the Adirondacks, in Lewis, Hamilton, and some other counties of northern New York. This has not been the case, however, for more than twenty years.—A few are known to exist in the Alleghanies of Western Virginia. We next find them in the Southern part of Michigan, but it is only as we proceed farther West, that they present themselves in numbers. In Minnesota they are found in large herds, and in still larger on the Upper Missouri, Yellowstone, and other streams. Of the vast number in these regions, some idea may be formed from the piles of shed horns which the Indians are in the habit of heaping up in the prairies. One of these, on Elk Horn prairie, about eighty miles above Fort Union, has for many years been a conspicuous land-mark to the traveller, showing like a white monument many miles off. This which was torn down in the summer of 1850 was about fifteen feet high and twenty-five in circumference ; others still larger are found on the Upper Yellowstone."

In the Western prairies they congregate in herds of from twenty or thirty to six or seven hundred, and it is said that in those vast oceans of meadow the animal grows to a great size. Individuals nearly the size of a horse are not unfrequent. In California and New Mexico antlers, it is said, have been found so large that when resting on their tips a tall man could walk erect between them. Their food consists of the grass found in the woods, wild pea vines, the branches of willows, lichens, and the buds of the wild rose. During the winter they scrape the snow from the ground with the fore feet and eat the tender roots and bark of shrubs and small trees. They are fond of residing in wooded dells, islands covered with willows, or points on the river side, still clothed with forest. They make for themselves a bed upon the long grass, and occasionally upon the top of a fallen tree, where they sleep during the hot sultry hours of the day. During hot weather when mosquitoes abound in the woods, they retire to ponds or proceed to the rivers and immerse their bodies and heads, leaving merely enough of their noses above the water to allow them to breathe. A pair of them kept in confinement at New York by Mr. Audubon, were fed upon green oats, hay, Indian corn, and all such food as is usually given to a cow. Turnips they would not touch. The pair ate as much in a day as would suffice for two horses. *

The horns fall off in February or March, and are reproduced in four or five months to their full size, and during their growth are covered with velvet like those of the common deer. The young are brought forth in May or June, one or two at a birth.

The Wapite is easily domesticated and it is often to be seen in the parks of the wealthy, both in Europe and America. As they grow old, however, the males become exceedingly pugnacious, and will sometimes in a fit of passion attack their best friends.

In their wild state, where alone they can be seen in their full size and strength, they are shy and not at all easily approached by the hunter. The herd is led by the oldest and strongest male, and wherever he goes they follow. Their senses are acute, and they easily perceive the approach of any human intruder. "The moment the air is tainted by the odour of his enemy, his head is erected with spirit, his ears rapidly thrown in every direction to catch the sounds, and his large dark glitering eye expresses the most eager attention. Soon as the approaching hunter is fairly discovered, the elk bounds along for a few paces, as if trying his strength for flight, stops, turns half round, and scans his pursuer with a steady gaze, then throwing back his lofty horns upon his neck, and projecting his taper nose forwards, he springs from the ground and advances with a velocity which soon leaves the object of his dread far out of sight. *

In the Autumn the males are subject to ungovernable passion, roaming to and fro over the plains, and fighting most desperate battles with each other. Their cry is described as a shrill whistling, quivering noise, which can be heard at a distance of one mile, and is not very unlike the braying of a jackass. It is prolonged and acute, consisting of the successive sounds *a, o, u,* uttered with such vehemence as to offend the ear. While emitting this whistle or cry, they turn their heads upwards and backwards.

Godman says, the flesh of the elk is highly esteemed by the Indians and hunters as food, and the horns while in their soft state, are also a delicacy; of their hides a great variety of articles of dress and usefulness are prepared. The solid portion or shaft of the perfect horn is wrought by the Indians into a bow, which is highly serviceable from its elasticity as well as succeptible of polish and form. The teeth are much prized by the Indians also to ornament their dresses. A "queen's" robe of antelope's skins presented to Mr. Audubon, decorated with the teeth of fifty six elks, was valued at no less than thirty horses.

When wounded, it is said this animal fights with great eagerness, apparently not only to defend himself, but also to take revenge for the injuries he may have received.

* See Audubon and Bachman's Quadrupeds of North America, vol. 2, pages 90 and 91.

See Professor S. F. Baird, on the "Ruminating Animals of North America," Patent Report, Washington, 1851, Part 2, Agriculture, page 116.

Godman's American Natural History, vol. 2, page 111.

Nomenclature.—The following are the principal names under which this noble animal has been recognised by various authors:—

[(*Cerf du Canada,*) Perrault, Mem. Sur les Anim, vol. 2, p. 45; (*Cervus Major Americanus*) Catesby Carol, App. 2, 28; (*Alces Americanus, cornibus teretibus.*) Jefferson Virginia, p. 96; (*The Stag.*) Pennant Arctic Zoology, vol. 4, p. 27; (*Wewaskiss,*) Hearne's Journal, page 360; (*Red Deer,*) Umfreville; (*Cervus Strongyloceros,*) Schreber Saugthiere, vol. 2, page 1074; (*Wapiti.*) Warden des Etats Unis; (*Cervus Canadensis,*) Synopsis of the Species of Mammalia, Griffith's Cuvier, page 776; (*Elaphus Canadensis,*) DeKay, New York, Fauna, page 118; and also Audubon & Bachman's Quadrupeds of North America, vol. 2, page 83.]

In Knight's Cyclopædia of Natural History, vol. 1. pages 815 and 816, there is a new classification of the Deer family. In this arrangement the genus Elaphus is suppressed altogether, and the Wapite is called (*Cervus Canadensis,*) the European Stag, (*Cervus elaphus.*)

The Wapite, or Canadian Stag, is commonly called the Elk in the United States and Canada, although it is a member of a very different genus. This misnomer is perhaps one of the most remarkable in Natural History, and is still practised, even by the best authors, though probably out of deference to the popular custom. In Europe no person would think of confounding the Red Deer or Stag of the British Isles with the Elk of Scandinavia. No two animals could well be more unlike each other, and yet be contained in a single family. The Elk and the Stag of Europe both belong to the family Cervidæ or Deer, but they differ more widely from each other than the Horse does from the Zebra, and it would scarcely be possible to convince any person that they could be the same species.

Now, in America we have two species, the exact counterparts of the two in Europe, each to each. We have the Wapite with round branching antlers, and canine teeth in the upper jaw of the male, and in all general characters closely resembling the English Stag. It is only specifically distinct, being larger, its tail shorter, and slightly differing in colour. On the other hand, we have the Moose with huge flat horns, no canine teeth in the upper jaw, and a long pendulous upper lip, the whole animal being so exactly like the Elk of Europe, that the best naturalists are yet undecided as to the propriety of separating it as a distinct species. The moose therefore is a true elk, and the Wapite is a true stag or "Deer," in the common acceptation of that word. Yet, by a strange perversion of terms, the name of the one animal has been transferred to the other, and vice versa. The "Elk" in America is called a "Deer," and the "Deer" is called an Elk.

The Wapite has been nearly, if not quite exterminated in Canada since the arrival of the Europeans, and it should therefore be regarded by the Naturalists of this Province with an especial amount of interest. We have been informed that it still exists in the western counties of the upper province, but cannot testify from personal observation to the truth of this statement.

NOTE.—Professor Owen ranks certain remains of the English Stag among the fossils of the British Isles. He says, "the most common fossil remains of the Deer-Tribe are those which cannot be satisfactorily distinguished from the same parts of (*Cervus elaphus*,) which most abounded in the forests of England until the sixteenth century, and which still enjoys a kind of wild life, by virtue of strict protecting laws, in the mountains of Scotland.

The oldest stratum in Britain yielding evidence of a *Cervus* of the size of the Red-deer, is the red-crag at Newbourne. More conclusive evidence of the specific character of this sized Deer is afforded by antlers as well as teeth and bones, and these attest the existence of the *Cervus Elaphus* through intermediate formations, as the newer fresh water pliocene, and the mammoth silt of ossiferous caves, up to the growth of existing turbaries and peat bogs. I found remains of this round antlered Deer in all the collections of mammalian fossils from the fluvio marine crag, and more recent fresh water and lignite beds in Norfolk, Suffolk, and Essex. Similar remains have been obtained from the lacustrine deposits in Yorkshire; the head, with antlers, two feet ten inches in length, figured by Knowlton in the "Philosophical Transactions" for 1746, pl. 1, fig 2, was dug out of a bed of sand in the river Rye, in the East Riding of that country. OWEN'S BRITISH FOSSIL MAMMALS AND BIRDS, pages 472 and 473.

ARTICLE XI.—*On the Common Deer, (Cervus Virginianus.)*

(GENUS CERVUS.)

DENTAL FORMULA.

Incisive, $\frac{0}{8}$; *Canine,* $\frac{0}{0}-\frac{0}{0}$; *Molar,* $\frac{6}{6}-\frac{6}{6}$.—32.

Horns always present in the male, branched, sub-palmated or simple, the horns arising rounded from a burr or rose shaped base, ears large, no canine teeth, a muzzle, tail short and bushy.

The generic name is from the Latin (*Cervus*,) a deer. There are five species of the genus in North America. (see note page 61, last number,) of which only one (*Cervus Virginianus*) ranges into Canada.

CERVUS VIRGINIANUS, (Say.)

Reddish or bluish grey, according to the season, young spotted with white, horns of moderate size, curving forward, with the concave part in front, with from one to six points, occasionally palmated.

The Virginian deer is a beautiful and graceful animal still abounding in all the newer settlements of Upper Canada, and also though less numerously throughout the South-eastern and Western portions of Lower Canada. In form it is perhaps the most elegant of all the North American deer. It has a long tapering pointed head, and large lustrous bluish black eyes. The legs are slender, but well formed, and in proportion to their size, possessed of prodigious muscular strength, while the body is moderately stout and flexible. The horns are not large, but they are well armed with strong and sharp spikes. They are near their base bent backwards, and in the upper half turned forward. They are usually cylindrical, but they are also sometimes met with a good deal palmated. They vary very much in size and shape, upon different individuals. The prongs are round, conical, sharp, and directed upwards. Situated partly on the inside of each horn near the base there is a short brow antler on most of the specimens. A large pair of horns weigh about six pounds, but there are few over four or five pounds in weight.

The colour of this animal varies with the season; in the autumn and winter it is bluish gray, in the spring reddish, becoming bluish in the summer. Beneath the chin, throat, belly, inner surface of legs, and under side of tail, white. The fawns are at first reddish brown, and spotted with white along the sides. In the autumn of their first season they lose the white spots, and thereafter are the colour of the old ones. The hair is flattened and angular, that upon the under side of the tail long and white.

The average length of this species is, from the nose to the root of the tail, 5 feet 4 inches; length of tail without the hairs, 6 or 7 inches; with the hairs, a little more than one foot.

The females bring forth in May or June, one or two, rarely three at a birth.

In Canada this deer spends the winter in the cedar and spruce swamps, where, like the Moose, it "yards," as it is called in considerable herds. The yard is simply that tract of the swamp, where a herd of the deer have taken up their quarters, and is marked by a multitude of paths through the snow in all directions. At this season their tracks are seldom seen on the hard wood lands, but in the spring as soon as the snow has thawn away they leave the swamps and thereafter during the summer and autumn they reside in the uplands, and frequent the fields during the night. In the swamps their food consists principally of the buds of the birch, cedar and spruce, with some of the mosses. In the summer they feed upon leaves, tender grasses, berries, peas, turnips, and even commit extensive robberies upon the potatoe fields. They seem to prefer peas and turnips to all other agricultural productions. They are fond of lingering all day in the neighbourhood of the fields. The buck generally makes a comfortable bed for himself in a clump of low bushes where there are plenty of soft leaves or grass, and there sleeps

NOMENCLATURE.—(*Cervus.*) Latin, a deer. The Virginian or Common Deer has been variously described by authors and travellers under the names of (*Amerikanischer Hirsch.*) German, American Deer; (*Virginischer Hirsch.*) German, Virginan Deer; (*Cerf de la Louisiana.*) French, "the Stag of Louisiana," Fallow Deer and American Stag. The appellation (*Cervus Virginianus,*) Virginian Deer, is that bestowed upon it by the American Naturalist (SAY,) whose name is appended above. In the new classification of the deer given in the English Cyclopædia, this species is called (*Cariacus Virginianus.*) We shall give this new arrangement of the *Cervidæ* entire at the end of the next article.

The following are the differences between the four Genera of Deer described in this work:—

1st. Genus (*Cervus.*) The males only have horns, and there are no canine teeth in either sex.

2nd. Genus (*Elaphus.*) The males have horns and canine teeth, the females have neither.

3rd. Genus (*Tarandus.*) Both the males and the females have horns and canine teeth.

4th. Genus (*Alces.*) Horns and teeth the same as in the genus (*Cervus,*) but the horns are very broadly palmated, and the whole anterior of the animal, including the head and the neck, very different in structure from any other Deer. We have met with no description of the genus (*Alces.*)

during the greater part of the day. In the latter end of May, and in the month of June, when the flies are troublesome, they come out into the fields towards the close of the day, generally about an hour before sunset.—They also frequent the water in the night at this season to protect themselves from the flies. In certain sections of the country, particularly where the Utica Slate underlies the surface, there are numerous saline springs. The deer are very partial to the water of these springs, and hence they have received the name of "Deer licks." A method of killing them in the newer settlements is much practised by the younger hunting community, as follows: In some branching tree near the "Deer Lick," a scaffold is constructed with a seat sufficient to contain one or two persons. Armed with a rifle or a smooth barrelled gun well charged with buck-shot, or one or two bullets, the hunter towards night ascends into this nest and waits until the unsuspecting animal arrives to take his evening draught. It generally approaches cautiously, but examining only the objects on the ground in the neighbourhood of the spring. The enemy in the tree above is not noticed until the deadly report reveals him often too late. They resort to these licks in the evening, during the night and in the morning—not so frequently during the day. It is said that they content themselves with merely sipping the water and licking the saline matter from the stones. We have often observed them and seen them drink a good deal of the water. The old bucks are exceedingly wary, and not easily approached unless when intensely engaged in feeding in a pea field, or when the hunter stumbles upon one while half asleep in his lair. In the months of October, November, and December, they run furiously through the woods, following particular paths. They will often then brush close by a person without perceiving him. At this season we have seen them running swiftly along a "Deer path" with their heads low down near the ground, in the manner of a hound hunting by scent. The bucks have furious battles with each other, using both horns and feet; sometimes the horns of the combatants become so entangled that they cannot be separated—both then perish by hunger, or become the prey of other animals. The American Naturalist Say, gives the following instance:—"As the party were descending a ridge, their attention was called to an unusual noise proceeding from a copse of low bushes, a few rods from the path. On arriving at the spot they found two buck deers, their horns fast interlocked, and both much spent with fatigue, one in particular being so much exhausted that he could not stand. Perceiving that it would be impossible that they should extricate themselves, and must either linger in their present situations, die of hunger, or be destroyed by the wolves, they despatched them with their knives, after having made an unavailing attempt to disentangle them."—Beyond doubt, many of these animals must annually thus perish.

They are fattest in autumn, but in December the bucks become lean, while the does are fat until the middle of the winter. In the spring they are very thin and feeble. A barbarous method of hunting the deer at this season, is to attack them in their "yards." A party of men with a number of dogs seek out one of those places and set their curs in pursuit.—

The terrified deer runs in all directions, following their beaten paths through the snow. The hunter stands by and fires at the animals as they pass.—These slaughters take place generally in the month of March, when the snow is deep and covered with a crust, upon which the dogs can run and the men walk easily with their snow-shoes, while the unfortunate deer with its sharp feet sinks through at every bound, wounding its legs and marking its course with blood.

The laws for the protection of deer prohibits, under a fine, the killing of them at any period between the first of February and the first of September, but it unfortunately happens that this law is seldom enforced, and in consequence great numbers of these animals are slaughtered in their yards at a time of the year when neither their skins nor their flesh is of any value.

In still hunting or stalking the deer in the woods, it is necessary to practice great caution. When the first snow falls, the hunter follows their tracks as silently as possible until he can get a shot, which is not his good fortune every day. An old buck when he knows you are on his trail, will lead you many a weary mile without favouring you with a view of his majestic person. At first the track is found, and traced perhaps several hours until the hunter is within easy rifle shot, when the breaking of a fallen branch beneath the feet is sufficient to put the animal upon his guard. He listens eagerly, and his quick eye soon catches the outline of his pursuer, and after regarding him for a moment, he sets off at a dashing speed. He runs several hundred yards, then stops, listens and watches again. The hunter approaches, but the eye of the deer is the keenest in the forest, and you may follow on the track a whole day and never get a sight of the intended victim, although he may be at no time more than one quarter of a mile in advance.

Another method of hunting the deer practised in Canada is by driving them into the lakes or rivers with hounds. When pursued by the dogs, this animal at once flies to the water, his instinct perhaps influencing him to break the scent by crossing a stream. Some of the party are stationed at those points where the deer have their favourite crossing places, and when they approach may get a shot. This method, as well as every other, is not always successful. Often the deer takes a long round through the forest and run towards some distant water, in which case there can be no sport that day, and often the dogs are led so far away that they do not return for several days, and are, in fact, occasionally lost altogether.

Hunting with a lantern is also practised. A tall cylindrical cap of birch bark, with an opening in front, is placed upon the head, a lighted candle is placed inside so that the light is immediately over the brow of the hunter, and thus whilst it attracts the deer shines along the barrel of the gun when aim is being taken. The deer sees the light, and remains gazing steadily at it, while, at the same time, his eyes appear in the dark like two coals of fire. An easy shot may be thus obtained. This method, or one similar in principle, carrying a torch instead of a lantern, and gliding along a river in a canoe at night, is also practised with much success.

The deer when suddenly started in a field, does not make off at its full speed. The long hairs of its tail are bristled up suddenly, like those of a cat at the sight of a dog. The animal for a distance of two or three hundred yards proceeds by lofty bounds, alighting at each spring upon three of its feet, upon one side and then upon the othr. This gives to the body and tail, which is held erect, and expanded into a tall white brush, a rocking motion which cannot be well understood until seen. Soon, however, the prodigious bounds subside into lengthened leaps, and the animal stretches out, lies down as it were to the work, and is soon out of sight.

On the open plains, however, a well mounted horseman or a grey hound will easily run down a deer. This method of pursuing them has been practised in the Southern States where there are large plains.

The female brings forth in May or June, and conceals her fawns in a clump of bushes, where they remain coiled up while she feeds at no great distance. They will sometimes when found where placed by the dam, lie perfectly still, and suffer themselves to be taken without attempting to escape.

The horns of the buck fall off in January or February. They sprout again in the latter end of May, and in September the velvet is rubbed off.

The flesh of this animal is excellent, and the skin is famous for its durability and pliancy. The Indians soak the hide and scrape off all the hair, then smear it with the brains of the animal which have been preserved for that purpose, and by repeatedly rubbing and pulling, reduce it to a sufficient degree of softness. It is then hung over a fire of rotten wood and smoked, a process which is said to prevent the leather from becoming hard after being wet.

The Indians in the West consume every part of the deer, even to the contents of the stomach. It is said that the half digested vegetables in the stomach of a deer are not unpalatable, even to a white man. We should, however, prefer performing the process of mastication for ourselves.

This deer is easily domesticated, but makes a troublesome pet.

Geographical Distribution.

Cervus Virginianus ranges from the Gulf of the St. Lawrence across the British provinces, and the United States to the Rocky Mountains.—West of the Rocky Mountains it is unknown, except in Mexico. We have not ascertained its existence on the north shore of the St. Lawrence, below Quebec. West of Montreal it is found throughout Upper Canada. In the tract of hilly country lying north of the Great River, Ottawa, it extends 150 miles north of that stream; and indeed some of the fur traders informs us that it is found rarely near the height of land between Canada and the Hudson's Bay Territory. In the country around Lakes Nippissing and Temiscamang, isolated bands of this deer are occasionally met with. In the County of Renfrew, on the rivers Madawaska and Bonnechere, it is at present very abundant, although twenty-five years ago it was rarely seen in that part of Canada. It ranges over the whole of the United States, being more common in some of the States than in others. It is very abundant in Texas and New Mexico. It is not found in Oregon or California, being there replaced by other species.

Messrs. Audubon & Bachman state that the specimens they "saw in Maine and at Niagara were nearly double the size of these on the hunting islands in South Carolina. The deer that reside permanently in the swamps of Carolina, are taller and longer legged than those in the higher grounds.—The deer of the mountains are larger than those on the seaboard, yet these differences the result of food or climate, will not warrant us in multiplying them into different species."

ARTICLE XII.—*On the Mule Deer, (Cervus Macrotis.)*

CERVUS MACROTIS, (Say.)

Characters.

Horns cylindrical, twice forked; ears very long; body above, brownish grey; tail short, above, pale reddish ash colour, except at the extremity on its upper surface, where it is black; hair on the body coarse, like that of the Elk; very long glandular openings on the sides of the hind legs. (Audubon & Bachman.) *Inhabits the Eastern slope of the Rocky Mountains, ranges into the Hudson's Bay Territory, North West of Lake Superior.*

The only other species of the deer tribe we have ascertained satisfactorily to range into the British possessions of North America, is the Mule Deer, an animal intermediate in size between the common deer and the Canadian Stag. It is said to be a beautifully formed, graceful and powerful animal, its great ears being its only deformity. The horns are cylindrical, and twice forked. About the centre of their length they divide into two equal branches, and each of these is again divided near its exeremity. Near the base of each horn there is also a small prong like that on the horn of the common deer. The curvature of the antlers is nearly the same also in these two species.

The general colour is yellowish brown; nose, sides of face, belly, and inside of legs, greyish white; there is a line of dark brown along the back from the tail to the forehead; point of tail for two inches black, The tufted gland on the inside of the leg is six inches long in this species, and the lachrymal sinus is larger than that of (*Cervus Virginianus.*)

The female of this species is larger than the large bucks of the Virginian deer, and the male still larger. It is a wild and cautious animal, which abandon a territory as soon as it becomes inhabited. Its geographical range is along the east side of the Rocky Mountains from Texas to the Sascatchewan river, in the British possessions. Very little appears to be known about its habits. It is said the female brings forth one or two in May or June. Prof. Baird, in the article to which we have so often referred, says

Nomenclature.—(*Cervus*) Latin. a deer; (*Macrotis*) Greek, from (*Makros*, long, and *Ous*, *Otos*, ear,) literally the long eared deer. The other names are *Great Eared Deer, Jumping Deer, Black Tailed Mule Deer,* and *Cerf Mulet*.

"the Black Tail Deer is the largest of the true deer of the restricted genus (*Cervus*,) found in North America. It derives its specific name (*Macrotis*) from the great length of the ears, resembling those of the mule, whence it is sometimes called mule deer. Its more common appellation, black tail, is owing to the black tip to the tail. In size it is considerably larger than the common Virginian deer.

"This species is limited in its range by the Missouri river, east of which it is seldom seen. In ascending this stream it is found on Vermilion river, increasing in number northwards to the Sascatchewan. In the Black Hills it is very abundant, as well as in the most of the Rocky Mountain ranges, even as far south as Texas. It is, however, confined to the eastern side of the mountains, being replaced towards the Pacific by the closely allied *Cervus Richardsonii*."

The mule deer does not extend its range into any portion of Canada, and we have no accounts of its remains having been discovered in this country. It is probable therefore that its present habitation is that assigned to the species.

The *Cervus Richardsonii* above mentioned is a smaller animal, with a black tail, very common in Oregon, and is said to range along the western coast of North America to the Russian possessions. If this be true, then it should also be included among those inhabiting the British possessions.—But until we learn more about it, we prefer not to place it in the catalogue.

NEW GENERAL CLASSIFICATION OF THE DEER.

The following is the new classification of the Deer family to which we have several times referred in the six preceeding articles :—

The dental formula of the deer is, generally speaking, the same as in the giraffes, goats, antelopes, sheep, oxen, &c, ; namely,

$$\text{Incisors,} \frac{0}{8}\text{; Canines,} \frac{0-0}{0-0}\text{; Molars,} \frac{6-6}{6-6}=32.$$

Of the molars, both in the upper and lower jaw, six are true and six false. In the upper jaw the three first molars are bordered by a thick crest on their internal surface; the three next have all the characters of the molars in the dromedaries. In the lower jaw the first incisor is the longest, the second and the third rather decrease, and the fourth is very small; all have cutting edges. The two first false molars are simple; the third has a process or heel at its posterior part, and the three others do not differ from those of the upper jaw. In the formula given above the canines are noted as absent; but this general rule is not without exception, some of the species presenting canines similar to those of Musks (*Moschus*) in the upper jaw. Muntjak has these teeth largely developed.

The Deer-Tribe possess the Lachrymal Sinus, or, as it is often termed, the Suborbital Sinus (Larmiers of the French, Tear-Pits of the English, Crumen of others.) even more universally than the Antelopes.

The late Mr. Bennett was of opinion that the use of the lachrymal sinus, which has long remained a problem to zoologists, must be referred to sexual relations. In support of this opinion he has referred to the condition of this organ in some old Indian Deer formerly in the possession of the Zoological Society in the Gardens in Regent's Park.

Professor Owen at one time conceived it possible that the secretion of these glands, when rubbed upon projecting bodies, might serve to direct individuals of the same species to each other. He endeavoured to test the probability of this supposition by preparing a tabular view of the relations between the habits habitats of the several species of Antelopes and their suborbital, maxilliary, post-auditory, and inguinal glands, in order to be able to compare the presence and degrees of development of these glands with the gregarious and other habits of the Antelope-Tribe. He has stated, however, that it was evident from this table that there is no relation between the gregarious habits of the Antelopes which frequent the plains and the presence of the suborbital and maxillary sinuses; since these. besides being altogether wanting in some of the gregarious species. are present in many of the solitary frequenters of rocky mountaineous districts. The supposition therefore that the secretion might serve, when left on shrubs or stones, to direct a straggler to the general herd. falls to the ground. ('Zool. Proc.,' 1836.)

The osteological structure of the Deer-Tribe is such as would be expected when it was necessary that the bony framework should exhibit a union of lightness and strength necessary for an animal whose life is to depend on its agility and defensive powers.

The *Cervidæ* are widely spread, and seem capable of being so modified as to withstand the extremes of heat and cold.

The following arrangement of the Deer is proposed by Dr. J. E. Gray:

A. The Deer of the Snowy Regions have a very broad muzzle, entirely covered with hair. The horns are expanded and palmated; and the fawns are not spotted.

a. The Alcine Deer have no basal anterior snag to the horns, and a small bald muffle between the nostrils, as the genus *Alces*.

b. The Rangerine Deer have a large basal anterior snag to the horns close on the crown or burr. and no muffle. as *Tarandus*.

B. The Deer of the Temperate or Warmer Regions have a tapering muzzle ending in a bald muffle. The fawns, and sometimes the adults, are spotted.

c. The Elaphine Deer have a distinct anterior basal snag to the horns, the muffle broad, and separated from the lip by a hairy band; and the tuft of hair on the outside of the hind leg, above the middle of the metatarsus, as *Cervus* and *Dama*.

d. The Rusine Deer have a distinct anterior basal snag to the horns; the muffle very high, and not separate from the edge of the lips: and the tuft of hair on the outside of the hind leg, above the middle of the metatarsus, as *Rucervus*, *Panolia*, *Rusa*, *Axis*, *Hyelaphus*, and *Cervulus*.

e. The Capreoline Deer have no basal anterior snag to the horns, the first branch being some distance above the burr; the crumen (and pit in the skull) generally small, as *Capreolus*, *Cariacus*, *Blastocerus*, *Furcifer*, *Coassus*, and *Pudu*.

The Alcine and Rangerine Deer are confined to the northern part of both continents; the Elaphine and Rusine Deer to the Eastern World (the latter almost exclusively to the warmer part of Asia); all the Capreoline Deer are peculiar to America. The only exception to these rules are—the Wapite Deer of the Elaphine group is found in Northern America, and the Roe-Buck and Ahu of the Capreoline group are found in Europe and Northern Asia.

The following is an arrangement of the genera and species of the tribe *Cervina* of Gray :—

Sub-Tribe 1. Alceæ.

Genus, *Alces*.

1. *A. Malchis*, the Elk.

Sub-Tribe 2. Rangerinæ.

Genus, *Tarandus*.

2. *T. Rangifer*, the Caribou or Rein-Deer.

Sub-Tribe 3. Elaphinæ.

Genus, *Cervus*.

3. *C. Canadensis*, the Wapiti.
4. *C. Elaphus*, the Stag.
5. *C. Barbarus*, the Barbary Deer.
6. *C. Wallichii*, the Bara Singa.
7. *C. affinis*, the Saul-Forest Stag.
8. *C. Sika*, the Sika.

Genus, *Dama*.

9. *D. vulgaris*, the Fallow-Deer.

Sub-Tribe 4. Rusinæ.

Genus, *Panolia*.

10. *P. Eldii*, the Sungnai.

Genus, *Rucervus*.

11. *R. Duvaucellii*, the Bahrainga.

Genus, *Rusa*.

12. *R. Aristotelis*, the Samboo.
13. *R. Dimorphe*, the Spotted Rusa.
14. *R. Hippelaphus*, the Mijangan Banjoe.
15. *R. equinus*, the Samboe.
16. *R. Peronii*, the Smaller Rusa.
17. *R. Philippinus*, the Philippine Rusa.
18. *R. lepida*, the Sundervall Rusa.

Genus, *Axis*.

19. *A. maculata*, the Axis.
20. *A. pseudaxis*, the Spotted Axis.

Genus, *Hyelaphus*.

21. *H. porcinus*, the Lugna Para.

Genus, *Cervulus.*

22. *C. vaginalis*, the Kijung.
23. *C. moschatus*, the Kegan,
24. *C. Revesii*, the Chinese Muntjak.

Sub-Tribe 5. CAPREOLINÆ.

Genus, *Capreolus.*

25. *C. Capræa*, the Roe-Buck.
26. *C. Pygargus*, the Ahu.

Genus, *Blastocerus.*

27. *B. paludosus*, the Guazupuco.
28. *B. campestris*, the Mazame.

Genus, *Frucifer.*

29. *F. Antisiensis*, the Tarush.
30. *F. Huamel*, the Guemul.

Genus, *Cariacus.*

31. *C. Virginianus*, the American Deer.
32. *C. Mexicanus*, the Mexican Deer.
33. *C. leucurus*, the White-Tailed Deer.
34. *C. nemoralis*, the Cariacou Deer.
35. *C. punctulatus*, the Californian Roe.
36. *C. Lewisii*, the Black-Tailed Deer.
37. *C. macrotis*, the Mule-Deer.

Genus, *Coassus.*

38. *C. nemorivagus*, the Gauzu-viva.
39. *C. rufus*, the Cuguacu-ete.
40. *C. superciliarus*, the Eye-Browed Brocket.
41. *C. auritus*, the Large-Eared Brocket.

Genus, *Pudu.*

42. *P. humilis*, the Venada.

We shall conclude the articles upon the Deer of British North America with a paper read before the British Association in 1835, on the Lachrymal sinuses of these animals.

On the Infra-orbital Cavities in Deer and Antelopes, called Larmiers by the older French Naturalists. By ARTHUR JACOB, M. D., Professor of Anatomy in the Royal College of Surgeons of Ireland.

Read at the Meeting of the British Association held in Dublin, August, 1835.

In compliance with the recommendation of the Committee of the Zoological Section of the Association made at the meeting in Cambridge in 1833, I have availed myself of such opportunities as have been afforded me of investigating the nature, structure, and uses of these remarkable parts. To those altogether unacquainted with the subject it is necessary to state that they consist of two oval depressions about an inch and a half long, half an inch wide, and more than three quarters of an inch deep in the majority of instances; situated on the side of the face, and so near to the inner angle of the eye that they create a very reasonable suspicion that they are connected with that organ, and hence the term *larmier* applied to them. The bottom of the depression is in most cases naked, but in some it is covered with the hair, consequently it is composed of the skin formed into an open sac, accommodated in a corresponding depression in the bones of the face. In many animals provided with this organ, a gutter, formed by folds of skin, leads so directly to it from the surface of the eye, that the passage of the tears from the one place to the other appears inevitable; while in others this communication is so imperfect that a doubt is at once raised as to its destination to such a purpose. If the part in question be not a cavity, as suggested by some, in which the overflowing secretions from the surface of the eye are disposed of by evaporation, another reason for its existence must be assigned. The arguments which may be urged against the supposition that it is destined to receive the tears are, first, that it exists in the antelopes and deer only, and is even absent, or merely rudimental, in many of these; while in animals said to be destitute of the usual canals for carrying off the tears to the nose, as the elephant and hippopotamus, it is absent; secondly, that the solid concretions generally found in it are not composed of such ingredients as the tears and other secretions from the surface of the eye should afford.

If the conclusion that there are cavities for the reception of tears be discarded, their identity of nature and character with the numerous provisions for the secretion of peculiar or odoriferous materials suggests itself. In many instances, especially in the mammalia, glands are found opening on the surface of the skin, and pouring out peculiar fluids, sometimes altogether unconnected with any organ; such are the glands on the side of the head between the eye and the ear of the elephant, those described by Tiedemann between the eye and nose in certain bats, consisting of a sac with a folded lining membrane, affording a fœtid, oily secretion, and beneath the eye in the marmot and two-toed ant-eater; such also are the glands on the side of the chest of the shrew, described by St Hilaire, and the inguinal glands of hares. Still more remarkable examples are furnished by the pouches, affording the valuable odoriferous materials in the musk, beaver, and civet; and if additional examples be required, they are found in the otter, male hyena, ichneumon, badger, and the dorsal gland in the peccary. That the cavities alluded to in the deers and antelopes afford peculiar and often odoriferous secretions, is established on the authority of several naturalists. Buffon describes the contents in the stag as resembling ear-wax. Daubenton found the secretion in an old stag so much indurated as to constitute a solid mass, or bezoared, as he calls it, eleven lines long, seven broad, and six thick. Camper found hard, yellowish particles in the fallow deer. In a species of antilope first described by Dr. Herman Grimm, this organ secretes a fluid of such peculiar and distinct character that no doubt can be entertained of its nature. He describes it to be a yellowish, fatty, and viscous humour, having an odour between musk and camphor. Vosmaer says that it hardens and becomes black in time, and that the animal rubs it off on the rails of its cage, but he could not detect the musky odour, Pallas, who describes the Antilope grimmea particularly, concurs in these observations.

It may be objected to the conclusion, that these are organs for the production of an odoriferous secretion, that the sac exhibits so little of glandular character that it appears inadequate for the purpose, especially when several of the external openings alluded to, as that on the head of the elephant and the back of the peccary, are merely the outlets of considerable glands; but on the other hand, many organs of this character are mere sacs, as that on the face of the bats, the bottom of which presents a peculiar folded appearance, and the cavities in the musk and beaver, which afford the odoriferous secretion in such large quantity.

A statement respecting these infra-orbital cavities has been made by the Rev. Gilbert White in his Natural History of Selbourne, which might appear to originate in some error, were it not supported by the more recent testimony of Major Hamilton Smith. These gentlemen state, that when the deer drinks, the air is forced out through these cavities, and, according to Major Hamilton Smith, may be felt by the hand, and affects the flame of a candle when held to it. Notwithstanding such a positive statement by two observers of established character for faithful description, the passage of air through these cavities cannot take place, they are perfectly impervious toward the nostril; but I have no doubt that the fact stated is correct, the air which escapes passes, not through the infra-orbital sacs, but through the lachrymal passages, which are very large, consisting of two openings capable of admitting the end of a crow's quill, the entrance to a tortuous canal, which conducts the tears to the extremity of the nose. Introducing a pipe into the outlet of the nasal duct at the extremity of the nose, I can, without difficulty, force a current of air or water through the nasal duct; and it therefore appears reasonable to admit that the effect observed by the two gentlemen alluded to, arose from the animal forcing the air into the nostrils while nose and mouth were immersed in water. Even in the human subject air may be forced up the nasal duct into the lachrymal sac, by filling the cavities of the nose from the lungs while the nostrils are closed by the hand.

Persons following up this investigation should be aware that these cavities exist in a very imperfect state in many species, being, in fact, merely rudimental, and capable of affording the secretion which they are destined to provide in others. The last traces of the organ may even be detected in goats, sheep, and perhaps all the ruminants. It is a beautiful example of that adherence to an original type or model which is so conspicuous in animal organization, and as if in obedience to a law that all the ruminants should be provided with a sinus beneath the eye for the secretion of a peculiar matter, but that it should remain in an imperfect or unfinished state in those who do not require such additional aid to distinguish sex or recognise species.

Since the above was written I have had an opportunity of examining these sinuses in the Wapiti (*Elaphus Canadensis,*) and obtained from one of the cavities a large solid mass of the indurated secretion like that found in the sinuses of the stag by Daubenton, and called by him *bezoard de cerf.*—This, Dr. Geoghegan, the Professor of Medical Jurisprudence in the Royal College of Surgeons, has been kind enough to submit to analysis, the results of which corroborate the inference that the secretion found in the cavities is derived from the cavity itself, and not from the surface of the eye. The existence of the hairs and flakes of exfoliated cuticles in layers proves that the deposit is formed from the surface beneath, and not by evaporation of fluids trickling into the cavity. Dr. Geoghegan's account of the analysis I annex in his own words.

"The bezoard described by Dr. Jacob is covered by a fine transparent membrane, a good deal resembling goldbeater's leaf; within this, and arranged concentrically, are four or five laminæ, having a coriaceous appearance; these seem to be soaked with the dark brown matter which constitutes the great bulk of the mass. The thickness of these membranous coverings is altogether about a line and a half. The matter contained within this covering is of a dark reddish-brown colour, resembling indurated cerumen, and consisting apparently of a number of fine hairs matted together by a substance of an oleo-resinous appearance. This substance in one specimen was viscid and tenacious, and of the consistence of common turpentine; while in another it was more friable. Both exhaled a most peculiar odour resembling soft soap made with fish oil, but slightly pungent and aromatic. The more friable specimen had the smell of kreosote when much diluted. The specific gravity of the large mass 1,081. The material has a slightly bitter taste, but does not dissolve in the mouth, and imparts a very slight greasy stain to paper. When heated it swells, grows darker in colour, and undergoes a partial fusion; and if the heat be increased it takes fire, and burns with a bright flame and much smoke, leaving behind a greyish-white ash. A fragment digested with five successive portions of water, imparted to them the peculiar odour of the substance, which was, however, dissipated by evaporation. It appears therefore to contain a volatile odorous principle, which is so intimately combined with the other principles present, that even after digestion in the above mentioned number of waters, the residuum, which was but little acted on, possessed its peculiar odour nearly as strong as before. The aqueous solution afforded, on evaporation, a brownish extractive matter, with which nitrate of silver gave a copious precipitate of chloride of silver; and oxalate of ammonia indicated a salt of lime, most probably lactate. Another portion digested in æther coloured it yellow, and the solution on evaporation furnished a yellowish-brown transparent substance, very viscid and tenacious at ordinary temperatures, very readily fusible, and exceedingly soluble in caustic potash; immediately on uniting with them, it exhales strongly the smell of fish-oil soap. This solution is miscible with water without decomposition; acids precipitate a white matter, and when, subsequent to the addition of acid, the mixture is heated, an oily looking matter floats, and the rest of the fluid becomes turbid and milky. Cold alcohol digested on another portion took up a good deal of yellow viscid matter; and when evaporated furnished also some extractive, soluble in water, probably the same as that afforded by the aqueous solutions. Boiling alcohol, digested on the residuum, takes up more of the yellow matter, which, on evaporation, affords a more resinous looking residuum, the surface of which is covered with a greasy film, also saponifiable by caustic potash. Alcohol, digested on what remained after the action of æther, dissolved only a trace of saline matter; and the residuum, after exhaustion by æther, had the appearance of thin flakes of pearly cuticle, coloured yellowish-brown, insoluble in strong acid, but soluble in potash, from which it was precipitated by acetic acid. A portion of these flakes, when strongly heated, left a white ash, consisting of carbonate and phosphate of lime, carbonate of soda, and chloride of sodium. The materials then appears to consist of a number of hairs, with a quantity of delicate, cuticular flakes the whole intimately mixed with a dark matter, composed as follows: —a brownish, viscid, oily substance, probably containing resin; a volatile odorous principle; extractive, soluble in water and alcohol; colouring matter, which adheres to the flakes of cuticle; lactates of soda and lime, a trace of phosphate of lime, and chloride of sodium in considerable quantity."

ARTICLE XIII.—*On the American or Black Bear, (Ursus Americanus.)*

GENUS URSUS.

DENTAL FORMULA :—*Incisive,* $\frac{6}{6}$; *Canine,* $\frac{1}{1}$–$\frac{1}{1}$; *Molar,* $\frac{6}{7}$–$\frac{6}{7}$.

The bears have six incisive or front teeth in each jaw, next to which are four large and strong canine teeth or tusks, two above and two below; They have six molar or grinding teeth on each side of the upper, and seven on each side of the lower jaw. They have large heads, stout bodies and legs, and, in general, tremendous claws. They are plantigrade, or walk with the whole sole of the foot flat upon the ground. The tail is short; mammæ six; two pectoral and four ventral, and the body is usually clothed with a thick coat of shaggy or partly fur-like hair. They are omnivorus, and more nocturnal than diurnal in their habits. The generic name is from the Latin *ursus,* a bear. There are four species in the British territories of North America, of which the most common is the Black or American Bear.

URSUS AMERICANUS.

SPECIFIC CHARACTERS.—*Black or brownish black; a soiled brown or yellowish patch on each side of the nose. Facial outline somewhat arched. Young with hair wavy or curled. Inhabits all the woody regions of North America, except, perhaps, the south-western part of the continent.*

NOTE.—I have the skulls and jaws of two bears killed in the Township of Huntley, about two years since. In the upper jaw of each there are five molar teeth. There is a very small molar tooth immediately behind and close to the large canine tooth, then a space of $\frac{3}{4}$ of an inch without teeth, then another small molar, next a molar about twice the size of the smaller ones, then a very large tooth, and lastly a long and narrow molar. There are six molars only in the lower jaws, and they are arranged in the same manner, the small ones in the anterior portion behind the canine teeth.

The Black Bear has very stout legs, a somewhat bulky but flexible body, a long head, slightly arched from the nose over the forehead, small eyes, and ears high, oval and rounded at the tips. The soles of the feet are short—the hairs of the feet project slightly beyond the claws, which are short, blunt, and somewhat curved. The tail is very short, and the fur is long, glossy, and soft. The general colour is black, but it sometimes varies to brown or yellowish. One was killed on the Ottawa, three years since, in 1853, which was light yellowish brown. The sides of the nose are of a fawn colour, and there is sometimes a little white on the forehead and throat. In some specimens a small spot of white above the eye. The length of the animal is from four to six feet, and large ones, when fat, in the autumn, weigh 600 pounds.

The female brings forth two cubs in the winter, and in Canada the birth takes place before the hybernating retreat is deserted.

The food of the Bear is principally vegetable, consisting of roots, grapes, berries, acorns, beech nuts, and occasionally a feast of green oats or Indian corn. In the fields of the two latter in the months of Aug. and Sept. it sometimes, in the newer settlements, commits very considerable destruction not only by the quantity eaten, but by the injury the crop sustains from being broken down and trampled in the earth. It is, however, fond of flesh, and will carry off and devour hogs, and sometimes even attack horned cattle. "It will also devour eggs, insects, and small quadrupeds and birds; but when it has abundance of its favorite vegetable food, will pass the carcass of a deer without touching it."

Although a clumsy looking animal, yet the bear can run with much swiftness, and can travel great distances through the woods without rest. Dekay, in the Natural History of New York, gives an account of a bear which was pursued for eighteen days before it was finally killed. Although seldom seen during the chase, yet he appeared to be perfectly well aware that he was an object of pursuit, and when killed, the worn and lacerated condition of his feet testified to his exertions to effect his escape. It climbs with great facility, and when surprised in a corn field and pursued by dogs, after running a short distance it seeks for protection by ascending to the branches of a tree, where it remains until shot by the hunters. When the beach nuts and acorns are plenty, the bear climbs the trees in search of this favorite food. It then draws into its reach and breaks off large branches with its powerful fore limbs, and sometimes leaves such a collection of those broken boughs in one place in the top of the tree, that they resemble huge birds' nests. We have seen in some of the beach ridges, as they are called, twenty or thirty of those bears' nests in the trees within sight at once.

When driven to extremities the bear will stand up on his hind legs and make a desperate battle, in the manner of a boxer. One stroke of his powerful paw will disable a dog, or knock a gun or axe from the hands of the hunter. He fights with teeth, claws, and also by hugging his enemy to death. The sight and hearing of the bear are both acute, but although the animal evades the settled portions of the country and prefers the more solitary tracts of the forest, yet it does not appear much to dread the appearance of man. When met accidentally in the woods they evince no inclination to attack, and neither do they often shew any fear. Both parties, the man and the bear, appear on such occasions satisfied to pass on without quarrelling, unless indeed the former be armed. The females are strongly attached to their young, and are dangerous to be approached while these remain under their protection.

The winter retreat in the colder regions of North America is a hollow tree, a cleft in the rocks, or any place that may afford shelter. The animal retires to his den at the first fall of the snow, and where his lair is situated on the ground, as for instance under a fallen tree, the quantity of hoar frost accumulated around the breathing hole through the snow betrays him to the hunter. When they retire in the commencement of winter they are exceedingly fat, and what is very remarkable when they first leave their dens in the spring they are also fat, but in a few days thereafter become very lean. In Godman's Natural History it is stated that "in the north the flesh of the black bear is fittest for the table about the middle of July when the berries begin to ripen, though some berries impart a very disagreeable flavour to their flesh. They remain in good condition to the following January or February. Their flesh is rendered rank and disagreeable by feeding on herring spawn, which they seek and devour with greediness whenever it is to be obtained. The Southern Indians kill great numbers of these bears at all seasons of the year, but no inducement can be offered to prevent them singeing off the hair of all that are in good condition for eating, as the flesh of the bear is as much spoiled by skinning as pork would be, the skins these people bring the traders are consequently only such as are obtained from bears that are too poor to be eaten.

"In the vicinity of Hudson's Bay the black bear has been observed to feed entirely on water insects during the month of June, when the berries are not ripe. These insects of different species are found in astonishing quantities in some of the lakes, where, being driven by gales of wind in the bays and pressed together in vast multitudes, they die and cause an intolerable stench by their putrefaction, as they lie in some places two or three feet deep. The bear swims with his mouth open and thus gathers the insects on the surface of the water; when the stomach of the animal is opened at this season it is found to be filled with them, and emits a very disagreeable stench. They are even believed to feed upon those which die and are washed ashore. The flesh of the animal is spoiled by this diet, though individuals killed at a distance from the water are agreeably flavoured at the same season of the year.

"The black bear is in fact very indiscriminate in his feeding, and though suited by nature for the almost exclusive consumption of vegetable food, yet refuses scarcely anything when pressed by hunger. He is moreover voracious as well as indiscriminate in satisfying his appetite, and frequently gorges until his stomach loaths and rejects its contents. He seeks with great assiduity for the larvæ or grub worms of various insects, and exerts a surprising degree of strength in turning over large trunks of fallen trees, which when sufficiently decayed to admit of it, he tears to pieces in search of worms.

"During the season when the logger-head turtles land in vast multitudes from the lagoons at the south, for the purpose of laying, the black bears come in droves to feast on their eggs, which they dig out of the sand very expeditiously, and they are so attentive to their business, that the turtle has seldom left the place for a quarter of an hour before the bear arrives to feast upon her eggs." *

The bear is frequently taken in dead falls, constructed in the manner of a martin trap. Two heavy logs are procured and placed one above the other, with stakes driven into the ground upon each side to keep them in that position. A small box-like enclosure, two or three feet square, is made upon one side, open towards the logs only, and in this the bait is placed.— The uppermost log is then raised up about two feet, and supported by a stick in such a manner that the bear in order to seize the bait must pass with his head and shoulders between the logs. The bait is also so placed and fastened to a piece of wood connected with that which supports the log above the bear, that when it is seized the log falls upon the bear's back or neck. Clumsy as this contrivance is, many bears are actually caught by it. Many of our readers have never seen a martin trap, and we have thought it proper therefore thus concisely to explain its principle as used for capturing bears.

Godman gives the following account of a bear in a dead fall :—"The animal sat upon his fore-paws facing us, the hinder paws being pressed to the ground by a heavy weight of logs, which had been arranged in such a manner as to allow the bear to creep under, and by seizing the bait he had sprung the trap and could not extricate himself, although with his fore paws he had demolished a part of the works. After viewing him for some time, a ball was fired through his head, but it did not kill him. The bear kept his position, and seemed to growl defiance. A second ball was aimed at his breast and took effect, but he did not resign the contest immediately, and was at last despatched with an axe. As soon as the bear fell, one of the Indians walked up, and addressing him by the name of *Muck-wah*, shook him by the paw with a smiling countenance, as if he had met with an old acquaintance, saying, in the Indian language, he was sorry they had been under the necessity of killing him, and hoped the offence would be forgiven, especially as the *che-mosk-o-men* (white men) had fired one of the balls. The Indians consider this bear as one of the noblest objects of the chase, and they always manifest the highest degree of exultation when they are successful in killing one. Every part of the animal is valuable to them, even to its intestines and claws ; the latter are bored at the base and strung on deer's sinews, to be worn as ornaments. The flesh is considered most delicious food, and the fore paws an exquisite dainty.

"The fat of the bear is accummulated in different parts of the body to an excessive degree, towards autumn, after the animal has been plentifully

* Godman's Natural History, vol. 1, page 87.

supplied with food; the oil obtained by liquifying it is a well known popular remedy against baldness, as well as for rubbing stiff or rheumatic joints. The fat obtained from the paws is most highly prized, either because it is difficult to procure in any quantity or because it is really finer than that procured from the body generally. It is very certain that few, or indeed perhaps none of the animal oils are finer when properly prepared than that of the bear, and hence in any case where the external application of oil is thought proper, bears oil will be preferable to any other; but that it possesses many other virtues except those depending on its tenuity, we are not prepared to admit.

"The black bear, like all the other species of this genus, is very tenacious of life, and seldom falls unless shot through the brain or heart. An experienced hunter never advances on a bear that has fallen without first stopping to load his rifle, as the beast frequently recovers to a considerable degree, and would then be a most dangerous adversary. The best place to direct blows against the bear is his snout; when struck elsewhere, his dense, woolly, and thick hide, and robust muscles, render manual violence almost entirely unavailing. In common with other species of bear, it endeavours to suffocate its adversary by violently hugging and compressing its chest. It is said that a man might end such a struggle in a few instants, if one hand be sufficiently at liberty to grasp the throat of the animal with the thumb and fingers, externally, just at the root of the tongue, as a slight degree of compression there will generally suffice to produce a spasm of the glottis that will soon suffocate it beyond the power of offering resistance or doing injury."

The black bear has been found all over North America wherever there are forests, except, perhaps, in California. There is a yellow bear in the Southern States which appears to be considered the same species.

ARTICLE XIV.—*On the Grizzly Bear, (Ursus Ferox.)*

URSUS FEROX.

SPECIFIC CHARACTERS.—*Larger than the Black Bear; soles of feet and claws longer, and ears shorter than those af the Black Bear; colour, dark brown, with the tips of the hair paler or white; facial outline nearly straight. Inhabits the western side of North America, from the south-east corner of the continent to 61° of north latitude.*

(*Ferox*) Latin, fierce or ferocious, This animal has also been called, by various authors, "The Grizzly Bear," "White or Brown-grey Bear," "Grey Bear," "*Ursus Horribilis*," "*Ursus candescens*," and "*Ursus cinereus*."

The Grizzly Bear is described as resembling the Norwegian variety of the Brown Bear of Europe. The facial line from the nose to the forehead is nearly straight, or not arched, like the corresponding feature of the

Black Bear. The head is short and round, the nose bare; ears small; legs stout, and body large. The tail is very short, the feet large, and the claws very long, while those of the Black Bear are short. Eight hundred pounds is said to be the weight of an average specimen. The length of the fore-foot of a Grizzly Bear, killed in the Rocky Mountains, exceeded 9 inches, that of the hind foot $11\frac{3}{4}$ inches, and the breadth 7 inches. In one individual the claws of the fore feet measured 6 inches in length. The colour is variable, generally dark brown, tipped with white. The strength of the animal is amazing. It is said that he drags the carcass of a buffalo, weighing one thousand pounds, with ease across the prairie. Its activity is also very great, although it cannot climb trees like the black bear. Their food consists of wild fruits, roots and flesh. They sometimes seize upon wounded animals, such as deer or buffaloes, and having eaten part, bury the rest for future use. The following accounts of this animal are given by various authors:—

"This bear, justly considered as the most dreadful and dangerous of North American quadrupeds, is the despotic and sanguinary monarch of the wilds over which he ranges. Gigantic in size and terrific in aspect, he unites to a ferociously blood-thirsty disposition a surpassing strength of limb, which gives him undisputed supremacy over every other quadruped tenant of the wilderness, and causes man himself to tremble at his approach, though possessed of defensive weapons unknown to any but the human race. To the Indians the very name of the Grizzly Bear is dreadful, and the killing of one is esteemed equal to a great victory:—the white hunters are almost always willing to avoid an encounter with so powerful an adversary, and seldom or never wantonly provoke his anger.

"This formidable bear unhesitatingly pursues and attacks men or animals, when excited by hunger, or passion, and slaughters indiscriminately every creature whose speed or artifice is not sufficient to place them beyond his reach. The Bison, whose size and imposing appearance might seem to be a sufficient protection, does not always elude his grasp, as the grizzly bear is strong enough to overpower this animal, and drag its carcass to a convenient place to be deposited and devoured at leisure.

"However singular it may appear that an animal endowed with such a fondness for destruction and blood, can exist altogether on vegetable food, it is a fact that the grizzly bear, no less than all other species belonging to the same genus, is capable of subsisting exclusively on roots and fruits: this may be inferred from the peculiarities of their system of dentition. It is by no means surprising that hunters and travellers should suppose the grizzly bear to be almost wholly carnivorous, seeing that he displays such an unappeasable ferocity of disposition, and so uniform an eagerness to destroy the life of any animal that falls within his power.

"This bear at present inhabits the country adjacent to the eastern side of the Rocky Mountains, where it frequents the plains, or resides in the copses of wood which skirt along the margin of water courses. There is some reason to believe that the grizzly bear once inhabited the Atlantic regions of the United States, if we may be allowed to form any inference from traditions existing among the Delaware Indians, relative to the Big Naked Bear which formerly existed on the banks of the Hudson. The venerable HECKEWELDER informs us that Indian mothers used to frighten their children into quietness by speaking to them of this animal.

"Two cubs of the grizzly bear were sometime since kept alive in the menagery of PEALE's (now the Philadelphia) Museum. When first received they were quite small, but speedily gave indications of that ferocity for which this species is so remarkable. As they increased in size they became exceedingly dangerous, seizing and tearing to pieces every animal they could lay hold of, and expressing extreme eagerness to get at those accidentally brought within sight of their cage, by grasping the iron bars with their paws and shaking them violently, to the great terror of spectators, who felt insecure while witnessing such displays of their strength. In one instance an unfortunate monkey was walking over the top of the cage, when the end of the chain which hung from his waist dropped through within reach of the bears; they immediately seized it, dragged the screaming animal through the narrow aperture, tore him timb from limb, and devoured his mangled carcass almost instantaneously. At another time a small monkey thrust his arm through an opening in the bear's cage to reach after some object; one of them immediately seized him, and, with a sudden jerk, tore the whole arm and shoulder blade from the body, and devoured it before any one could interfere. They were still cubs, and very little more than half grown, when their ferocity became so alarming as to excite continual apprehension lest they should escape, and they were killed in order to prevent such an event.

"The grizzly bear is remarkably tenacious of life, and on many occasions numerous rifle-balls have been fired into the body of an individual without much apparent injury. Instances are related by the travellers who have explored the countries in the vicinity of the Rocky Mountains, of from ten to fourteen balls having been discharged into the body of one of these bears before it expired. In confirmation of these statements we shall here introduce some sketches from narratives given in the journals of Lewis and Clark, and Long's Expedition to the Rock Mountains.

" One evening the men in the hindmost of one of Lewis and Clark's canoes perceived one of these bears lying in the open ground about three hundred paces from the river, and six of them, who were all good hunters, went to attack him. Concealing themselves by a small eminence, they were able to approach within forty paces unperceived; four of the hunters now fired, and each lodged a ball in his body, two of which passed directly through his lungs. The bear sprang up and ran furiously with open mouth upon them; two of the hunters, who had reserved their fire, gave him two additional wounds, and one breaking his shoulder-blade, somewhat retarded his motions. Before they could again load their guns, he came so close on them, that they were obliged to run towards the river, and before they had gained it the bear had almost overtaken them. Two men jumped into the canoe; and the other four separated, and concealing themselves among the willows, fired as fast as they could load their pieces. Several times the bear was struck, but each shot seemed only to direct his fury towards the hunter; at last he pursued them so closely that they threw their guns and pouches, and jumped from a perpendicular bank, twenty-five feet high, into the river. The bear sprang after them, and was very near the hindmost man, when one of the hunters on the shore shot him through the head and finally killed him. When they dragged him on shore, they found that eight balls had passed through his body in different directions.

"On another occasion the same enterprising travellers met with the largest bear of this species they had ever seen; when they fired he did not attempt to attack, but fled with a tremendous roar, and such was his tenacity of life, that although five balls had passed through the lungs, and five other wounds were inflicted, he swam more than half across the river to a sand bar, and survived more than twenty minutes. This individual weighed five or six hundred pounds at least, and measured eight feet seven inches and a-half from the nose to the extremity of the hind feet, five feet ten inches and a-half round the breast, three feet eleven inches round the middle of the fore-leg, and his claws were four inches and three-eighths long.

"In fact the chance of killing the grizzly bear by a single shot is very small, unless the ball penetrates the brain, or passes through the heart. This is very difficult to effect, since the form of the skull, and the strong muscles on the side of the head, protect the brain against every injury except a very truly aimed shot, and the thick coat of hair, the strong muscles and ribs, make it nearly as difficult to lodge a ball fairly in the heart.

"Governor CLINTON, in the notes to his discourse delivered before the Literary and Philosophical Society of New York, says, "that Dixon, an Indian trader, told a friend of his, that this animal had been seen *fourteen feet long*; that notwithstanding its ferocity, it had been occasionally domesticated, and that an Indian belonging to a tribe on the head waters of the Mississippi, had one in a reclaimed state, which he sportively directed to go into a canoe belonging to another tribe of Indians, then returning from a visit: the bear obeyed, and was struck by an Indian. Being considered as one of the family, this was deemed an insult, resented accordingly, and produced a war between these nations."

"Mr. JOHN DOUGHERTY, a very experienced and respectable hunter, who accompanied Major LONG's party during their expedition to the Rocky Mountains, several times very narrowly escaped from the grizzly bear.—Once, while hunting with another person on one of the upper tributaries of the Missouri, he heard the report of his companion's rifle, and when he looked round beheld him at a short distance endeavouring to escape from one of these bears, which he had wounded as it was coming towards him. Dougherty, forgetful of every thing but the preservation of his friend, hastened to call off the attention of the bear, and arrived in rifle-shot distance just in time to effect his generous purpose. He discharged his ball at the animal, and was obliged in his turn to fly; his friend, relieved from immediate danger, prepared for another attack by charging his rifle, with which he again wounded the bear, and saved Mr. D. from further peril. Neither received any injury from this encounter, in which the bear was at length killed.

"On one occasion several hunters were chased by a grizzly bear, who rapidly gained upon them. A boy of the party, who could not run so fast as his companions, perceiving the bear very near him, fell with his face towards the ground. The bear reared up on his hind-feet, stood for a moment, and then bounded over him in pursuit of the more distant fugitives.

"Mr. DOUGHERTY, the hunter before mentioned, relates the following instance of the great muscular strength of the grizzly bear:—Having killed a bison, and left the carcass for the purpose of procuring assistance to skin and cut it up, he was very much surprised on his return to find that it had been dragged off, whole, to a considerable distance, by a grizzly bear, and was then placed in a pit, which the animal had dug with his claws for its reception.

"This bear strikes a very violent blow with his fore-paws, and the claws inflict dreadful wounds. One of the cubs before mentioned as belonging to the Philadelphia Museum, struck the other a blow over part of its back and shoulder, which produced a large wound like a sabre cut. It is stated in Long's Expedition, that a hunter received a blow from the fore-paw of a grizzly bear, which destroyed his eye and crushed his cheek bone.

"The grizzly bear is unable to climb trees like other bears; he is much more intimidated by the voice than the aspect of man, and on some occasions, when advancing to attack an individual, he has turned and retired merely in consequence of the screams extorted by fear. The degree of ferocity exhibited by the grizzly bear appears to be considerably influenced by the plenty or scarcity of food in the region it inhabits.

"The following are the dimensions of the specimen preserved in the Philadelphia Museum, as given by SAY:—

Length from the tip of the nose to the origin of the tail,..	5 ft. 2 in.
The tail, exclusive of the hair at the tip,..................	1¾
From the anterior base of the ear to the tip of the nose,.....	6
Orbit of the eye,....................................	¾
Between the eyes,....................................	6⅔
Ears from their superior base,........................	3
Longest claw of the fore-foot,........................	4½
Shortest,..	2¾
Longest claw of the hind-foot,........................	3
Shortest,..	1¾
Hair at the tip of the tail,..........................	4½
Length of the hair on the top of the head,...........	1¾ to 2
Beneath the ears,....................................	2½ to 3½
On the neck above,...................................	3
On the shoulders above,..............................	4½
On the throat,.......................................	4
On the belly and behind the fore legs the longest hairs are...	6

"These measurements are taken from two individuals which were by no means full grown, as may be perceived by comparing them with the measurements heretofore cited from Lewis and Clark. They will serve, however, to give a fairer idea of the proportions of this animal than any which have been previously given, as they are so much more detailed and very carefully made."

ARTICLE XV.—*On the White or Polar Bear* (*Ursus maritimus.*)

URSUS MARITIMUS.

SPECIFIC CHARACTERS.—*Head long and straight upon the facial outline. Skull flat; body and neck long, in proportion to the height; hair long, soft and white; larger than any other species of the genus; length, from* 8 *to* 9 *feet; height,* 4 *to* 5 *feet; weight, over* 1000 *lbs. Inhabits the northern regions of Europe, Asia, and America.*

The habits of this celebrated bear are such as to confine it, as its name indicates, constantly to the shores of the ocean. Being a powerful swimmer, and capable of enduring the most intense cold, its life is spent among the dreary ice-bergs in the Polar Seas, perhaps with as much enjoyment as those animals can experience whose organization adapts and limits them to the mild climate of the south. Notwithstanding its residence in the most inhospitable regions of the earth, in consequence of the many exploring and whaling expeditions that have been carried into the domain of the Polar Bear, his habits are as well known as those of any other species.

The food of this animal consists of the carcasses of whales, thrown on shore by the waves, dead fish, seals, land animals, birds, eggs, and berries. He is said to pursue young whales in the water and capture them. When he discovers a seal lying on the edge of the ice, he swims to the leeward of him and approaches by short dives, so arranging his distances that at the last dive he emerges from the water directly before his victim. Should the seal attempt to escape by rolling off the ice into the water, he falls into the jaws of his enemy, and should he lie still or attempt to move upon the ice, the bear, with a powerful spring, seizes and devours him.

It is said that the females only of this species sleep during the winter: "The males leave the land in the winter time and go out on the ice to the edge of the open water, in search of seals, whilst the females burrow in deep snow drifts, from the end of December to the end of March, remaining without food and bringing forth their young during that period; that when they leave their dens in March their young, which are generally two in number, are not larger than rabbits, and make a foot mark in the snow no bigger than a crown piece." According to another statement, the cubs, when they leave the den, are as large as a shepherd's dog, and this appears the most probable. The cubs, when tired in the water, ascend the back of the dam, who swims easily, carrying her young in this position.

"This animal swims excellently, and advances at a rate of three miles an hour. During the summer season he principally resides in the ice-islands, and leaves one to visit another, however great be the distance. If interrupted while in the water, he dives and changes his course; but he neither dives very often, nor does he remain under water for a long time. Captain Ross saw a polar bear swimming midway in Melville Sound, where the shores were full forty miles apart, and no ice was in sight large enough for him to have rested on."

They have been seen on ice-islands two hundred miles distant from land, and sometimes they are drifted to the shores of Iceland, or Norway, where they are so ravenous as to destroy all the animals they find. Most commonly such invaders are soon destroyed, as the natives collect in large numbers and commence an immediate pursuit, but frequently do not succeed in killing them before many of their flocks are thinned. An individual polar bear has occasionally been carried on the ice as far south as Newfoundland, but this circumstance very rarely occurs.

Generally the polar bear retreats from man; but when pursued and attacked he always resents the aggression, and turns furiously on his enemy. When struck at with a lance, he is very apt to seize and bite the staff in two, or wrest it from the hands. Should a ball be fired at him, without taking effect in the head or heart, his rage is increased, and he seeks revenge with augmented fury. It has been remarked that, when wounded and able to make his escape, he applies snow to the wound, as if aware that cold would check the flow of blood.

A great majority of the fatal accidents following engagements with the polar bear, have resulted from imprudently attacking the animal on the ice. Scoresby, in his interesting narrative of a voyage to Greenland, relates an instance of this kind. "A few years ago, when one of the Davis's Strait whalers was closely beset among the ice at the 'south west,' or on the coast of Labrador, a bear that had been for some time seen near the ship, at length became so bold as to approach alongside, probably tempted by the offal of the provisions thrown overboard by the cook. At this time the people were all at dinner, no one being required to keep the deck in the then immovable condition of the ship. A hardy fellow who first looked out, perceiving the bear so near, imprudently jumped upon the ice, armed only with a handspike, with a view, it is supposed, of gaining all the honour of the exploit of securing so fierce a visitor by himself. But the bear, regardless of such weapons, and sharpened probably by hunger, disarmed his antagonist, and seizing him by the back with his powerful jaws, carried him off with such celerity, that on his dismayed comrades rising from their meal and looking abroad, he was so far beyond their reach as to defy their pursuit."

In the morse or walrus this bear has an enemy of great power and fierceness, with which he has at times dreadful combats, most generally terminating in the defeat of the bear, as the walrus is armed with long tusks, capable of giving deadly wounds. The whale is also a perpetual enemy of the polar bear, chasing him from the waters it frequents, and killing him by blows with its tail. Notwithstanding, the bear succeeds in catching and feasting on many of the young whales.

The dwelling-place of the polar bear on shore is by no means well ascertained, but is most probably in caves, or some well concealed situation; it has been stated that they reside, during winter, in excavations made in the permanent ice; but Fabricius, from personal observation, declares the statement to be incorrect. Certainly this animal does not go to any great distance from the sea, on which he is almost exclusively dependent for food. Hence the flesh of the polar bear is generally fishy and rank, though it is said to be whitish, and similar to mutton. Captain Cook's people always preferred it to the flesh of the walrus or morse, yet they never considered it a very desirable food, except when none other was to be obtained. The fat resembles tallow, becoming as clear as whale-oil after liquefaction, and free from disagreeable smell; the oil obtained from the feet has been used medicinally, but except in fineness, has no qualities which the oil of other parts does not possess.

One of the most singular facts relative to the polar bear is, that its liver is to a great degree poisonous, a circumstance unknown in almost every other animal. Three of Barent'z sailors were very much injured by eating of it; and Capt. Ross, in his late Arctic voyage, verified the observation by experiment. The principle which imparts this noxious quality to the liver is as yet undiscovered; we know of no article of diet used by the animal, to which it can be attributed, and even if we did, this would not account for the deleteriousness of the liver, while all other parts of the body remain free from any injurious property.

The skin of the polar bear, dressed with the hair on, forms very substantial mats for carriages, or hall floors. The Greenlanders sometimes take it off without ripping up, and inverting the skin, form a very warm sack, which serves the purposes of a bed, the persons getting into it in order to sleep comfortably. It cannot well be dressed at any other than the winter season, on account of its great greasiness when freshly removed from the animal.—The nations residing in the vicinity of Hudson's Bay dress it in the following manner: they first stretch it out on a smooth patch of snow, and stake it down, where it soon becomes stiffly frozen. While in this condition the women scrape off all the fat till they come to the very root of the hair. It is occasionally permitted to remain in that situation for a considerable time, and when taken up it is suspended in the open air. When the frost is very intense, it dries most perfectly; with a little more scraping it becomes entirely dry and supple, both skin and hair being beautifully white. Notwithstanding that this bear is so large and powerful, his skin is both light and spongy.

The female polar bear is as rugged in her appearance, and as savagely ferocious in disposition, as her mate; yet to her offspring she displays a tenderness of affection which strongly contrasts with her fierce and sanguinary temper. When her cubs are exposed, danger has no existence to her, and nothing but death can compel her to desist from struggling desperately to defend or save them. The death of her offspring is with great difficulty acknowledged by the parent; when they are shot by her side the poor beast solicits their attention by every fond artifice, and endeavours to awaken them from their unnatural sleep: she offers them food, licks their wounds, caresses and moans over them in such a manner as to evince a degree of feeling which could scarcely be anticipated from so rude and terrible a quadruped.

Numerous instances of this fondness of attachment have been observed, and some of them attended with most singular displays of sagacity on the part of the mother. The following circumstance is related in Scoresby's account of the Arctic Regions, and is entitled to the fullest credence, because coming from so competent and excellent an observer:—

"A she bear, with her two cubs, were pursued on the ice by some of the men, and were so closely approached, as to alarm the mother for the safety of her offspring. Finding that they could not advance with the desired speed, she used various artifices to urge them forward, but without success. Determined to save them, if possible, she ran to one of the cubs, placed her nose under it, and threw it forward as far as possible; then going to the other, she performed the same action, and repeated it frequently, until she had thus conveyed them to a considerable distance. The young bears seemed perfectly conscious of their mother's intention, for as soon as they recovered their feet, after being thrown forward, they immediately ran on in the proper direction, and when the mother came up to renew the effort, the little rogues uniformly placed themselves across her path, that they might receive the full advantage of the force exerted for their safety."

The most affecting instance on record of the maternal affection exhibited by this bear, is related in one of the Polar Voyages; it conveys so excellent an idea of this creature's strong feeling of parental love, that we should deem the history of the animal imperfect, were such an illustration omitted:

"Early in the morning the man at the mast-head gave notice that three bears were making their way very fast over the ice, and directing their course towards the ship. They had probably been invited by the blubber of a sea-horse, which the men had set on fire, and which was burning on the ice at the time of their approach. They proved to be a she bear and her two cubs; but the cubs were nearly as large as the dam. They ran eagerly to the fire, and drew out from the flames part of the flesh of the sea-horse, which remained unconsumed, and ate it voraciously. The crew from the ship threw great pieces of the flesh, which they had still left, upon the ice, which the old bear carried away singly, laid every piece before her cubs, and dividing them, gave each a share, reserving but a small portion to herself. As she was carrying away the last piece, they levelled their muskets at the cubs, and shot them both dead; and in her retreat they wounded the dam, but not mortally.

"It would have drawn tears of pity from any but unfeeling minds, to have marked the affectionate concern manifested by this poor beast in the last moment of her expiring young. Though she was sorely wounded, and could but just crawl to the place where they lay, she carried the lump of flesh she had fetched away, as she had done the others before, tore it in pieces, and laid it down before them; and when she saw they refused to eat, she laid her paws first upon one, and then upon the other, and endeavoured to raise them up. All this while it was piteous to hear her moan. When she found she could not stir them, she went off, and when at some distance, looked back and moaned; and that not availing to entice them away, she returned, and smelling around them, began to lick their wounds. She went off a second time, as before; and having crawled a few paces looked again behind her, and for some time stood moaning. But still her cubs not rising to follow her, she returned to them again, and with signs of inexpressible fondness, went round first one and then the other, pawing them, and moaning. Finding at last that they were cold and lifeless, she raised her head towards the ship, and growled her resentment at the murderers, which they returned with a volley of musket balls. She fell between her cubs and died licking their wounds."

How long the female of this species goes with young has not been ascertained, but it appears quite certain that she brings forth during the winter season in her den.

In its geographical distribution, this animal ranges, in America, from Labrador along the eastern and northern coasts of America to the mouth of Mackenzie's River. Thence westward, they appear to be unknown on this continent. In the old world, it inhabits the Frozen Ocean, the coasts of Siberia, and the Islands of Nova Zembla and Spitzbergen.

The following measurements of the Polar Bear are given by Capt. Lyon, in the excellent and interesting narrative of his Arctic Voyage in company with Capt. Parry:—

Length—From the snout to the insertion of the tail, 8 ft. 7½ in.—the head only 1 ft. 6 in.—from the eye to the ear, 10 in.—from the nose to the centre of the eye, 8 in.—of the ear alone, 4½ in.—the tail from root to tip, 5 in.—fore-claws, 5½ in.—hinder claws, 1½ in.—canine teeth, 2½ in.

Girth—Round the body, 7 ft. 11 in.—neck, 3 ft. 4½ in.—fore-leg, 2 ft. 3 in.—hind-leg, 3 ft. 3 in,—round the snout, 1 ft. 9½ in.—round the forehead, 2 ft. 1 in.

Breadth—Paws, 10 in.—between the ears, 1 ft. 3 in.—canine teeth, 3 in.—[*Weight*, 1600 *lbs.*]

Capt. Lyon, in consequence of having seen a Polar Bear prowling about during the coldest part of the year, infers that Naturalists are mistaken in thinking that this animal becomes torpid during winter. We do not feel authorised to draw a similar conclusion from Capt. L.'s observation; especially as the habits of the *genus* in this respect are well known, and because the usual food of the polar bear must be extremely difficult to obtain, if it be at all accessible to the animal, during the severest part of the winter.—*Godman's Natural History.*

ARTICLE XVI.—*On the Cinnamon Bear (Ursus cinnamomum.)*

URSUS CINNAMOMUM.

SPECIFIC CHARACTERS.—*Form and size of the common American Black Bear, of which it is a permanent variety. Colour: above, dark cinnamon brown, nose and a fringe of hair covering the claws, yellow. Inhabits the fur countries west and north of the Missouri, extending to the Barren Grounds of the north-west.*—AUDUBON & BACHMAN.

The Cinnamon Bear is of the same size and form as the black bear, but all the individuals being of a different colour, and the hair being somewhat longer and finer, it has been thought proper to classify it as a distinct species, or rather as a permanent variety. The traders procure many of the skins each year, and they are much more valuable than those of the black bear, on account of the length and fineness of the fur. There is a bear described by Sir John Richardson, (*Ursus Arctos*) which appears to be the same as the present species. Sir John calls it the "Barren Ground Bear," it being found in that part of the Hudson's Bay Territory called the Barren Grounds. Its habits appear to be the same as those of the black bear. Several years since a bear was killed near the Chatts, on the River Ottawa, of a light reddish brown, which may have been of this species. In 1804, an expedition, under the direction of two adventurous explorers, Messrs. Lewis and Clark, was despatched from the States across the Rocky Mountains, to Oregon, and in the narrative of the journey the following account is given of this animal :—

"Two men visited the Indian village, where they purchased a dressed bear skin, of a uniform pale reddish brown colour, which the Indians called *yackah* in contradistinction to *hohhost*, or the white bear. This remark induced us to inquire more particularly into their opinions as to the several species of bears; and we therefore produced all the skins of that animal which we had killed at this place, and also one very nearly white, which we had purchased. The natives immediately classed the white, the deep and the pale grizzly red, the grizzly dark brown, in short, all those with the extremities of the hair of a white or frosty colour, without regard to the colour of the ground of the soil, under the name of *hohhost*. They assured us, that they were all of the same species with the white bear; that they associated together, had longer nails than the others, and never climbed trees. On the other hand, the black skins, those which were black, with a number of entire white hairs intermixed, or with a white breast, the uniform bay, the brown, and light reddish brown, were ranged under the class *yackah*, and were said to resemble each other in being smaller, and having shorter nails than the white bear, in climbing trees, and being so little vicious that they could be pursued with safety. This distinction of the Indians seems to be well founded, and we are inclined to believe, first, that the white or grizzly bear of this neighbourhood form a distinct species, which, moreover is the same with those of the same colour on the upper part of the Missouri, where the other species are not found; second, that the black and reddish brown, &c., is a second species, equally distinct from the white bear of this country, as from the black bear of the Atlantic and Pacific oceans, which two latter seem to form only one species. The common black bears are indeed unknown in this country; for the bear of which we are speaking, though in most respects similar, differs from it in having much finer, thicker, and longer hair, with a greater proportion of fur mixed with it, and also in having a variety of colours, while the common black bear has no intermixture or change of colour, but is of a uniform black." *

The four species of bears described in the preceding articles are the only ones known in North America, and they all range into the British territories. Messrs. Audubon and Bachman state:—"The Cinnamon Bear, so far as we have been able to ascertain, is never found near the sea coast. nor ever west of the Ohio valley, until you approach the Rocky Mountain chain, and it is apparently quite a northern animal."

ARTICLE XVII.—*On the Fossil Corals of the Lower Silurian Rocks of Canada.*

The corals of the Silurian rocks are among the most abundant of fossils, and on account of the important part the animals of which they are the remains have performed, in effecting extensive changes on the surface of the earth in various geological epochs, are particularly worthy of attention. Most persons have some idea of the existence of coral reefs, or great ridges of rock, some of them several hundreds of miles in length, formed of coral, in the oceans of the present day; but not all are aware that these reefs are found upon the dry land also, and extend even into Canada. Speaking of the Onondaga and corniferous limestones, Sir Charles Lyell says:—"Although in New York they have seldom a united thickness of more than 50 feet, they are observed to constitute an almost continuous coral reef over an area of not less than 500,000 square miles, from the State of New York to the Mississippi, and between Lakes Huron and Michigan, in the north, and the Ohio River and Tennessee in the south. In the western States they are represented by the upper part of what is called the "cliff limestone." There is a grand display of this calcareous formation at the

* Lewis and Clark's Travels, vol. 2, page 33.

falls or rapids of the Ohio River at Louisville, in Kentucky, *where it much resembles a modern coral reef.* A wide extent of surface is exposed in a series of horizontal ledges, at all seasons when the water is not high; and the softer parts of the stone having decomposed and wasted away, the harder corals stand out in relief, their erect stems sending out branches precisely as when they were living. Among other species I observed large masses, not less than five feet in diameter of *Favosites Gothlandica*, with its beautiful honey-comb structure, well displayed, and by the side of it, the Favistella combining a similar honey-combed form with the star of the *Astræa*. There was also the cup-shaped *Cyathophyllum*, and the delicate net-work of the Fenestella, and that elegant and well known European species of fossil called the "chain coral," *Catenipora escharoides*, with a profusion of others.—These coralline forms were mingled with the joints, stems, and occasionally the heads of lily encrinites. Although hundreds of fine specimens have been detached from these rocks to enrich the museums of Europe and America; another crop is constantly working its way out under the action of the stream, and of the sun and rain in the warm season when the channel is laid dry."

This corniferous limestone, "the coral reef," of which Sir Charles speaks, leaves the State of New York near Buffalo, and crosses into Canada where it constitutes, as we have stated in our first article, * nearly all the stratified rock that can be seen in the counties of Norfolk, Oxford, Perth, Elgin, Middlesex, Kent, Essex, and portions of several other counties adjoining these. It cannot, of course, be seen everywhere upon the surface, being for the greater part concealed beneath the drift formation, or those deposits of clay, sand, and gravel, which constitute the loose soil of the country; and again in some places where it can be seen, it is not composed altogether of coral, while in other localities the corals being liberated by the decomposition of the rock literally cover the ground.

In order to convey an idea of the nature of these fossil corals, we think it proper to make in this place a few observations concerning the organization of the humble, but interesting, and often most beautiful little animals, which in modern seas form the reefs by their accumulated remains. In the world of life there is a vast difference between the lowest and the highest of animated creatures, but geology shews us that the former have in all ages affected more in transforming the surface of the earth than the latter. The physiological structure of the coral animal consists of little else than a digestive cavity or stomach and a mouth leading into it, yet this simple apparatus has the power of withdrawing from the ocean the various elements held in its waters, and of converting them into rock. Myriads of these creatures swarming together, cover the sides of submarine mountains with one unbroken sheet of life and by constantly absorbing from the water the component parts of coral rock, and converting it into stone, they cause the ground, as it were, to grow beneath them. Every year a fresh layer is added to every portion of the space occupied by them, and their subaqueous mountain grows higher and higher until it reaches the surface, and becomes a coral island.

* See page 22 of the first number.

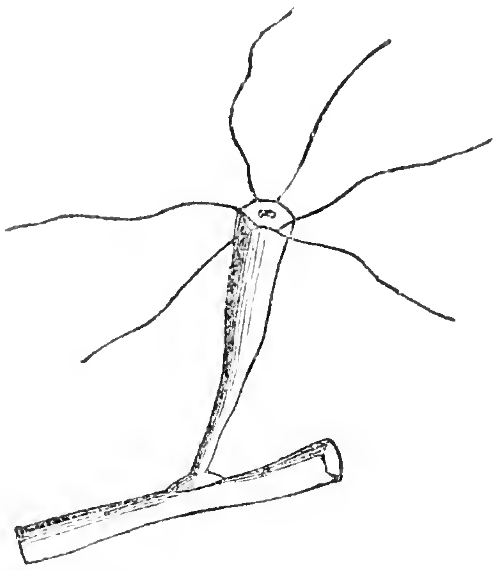


Fig. 1, *Ideal figure of a Hydra.*

In Fig. 1 is seen an ideal representation of a Hydra, a minute fresh water animal remotely related to the coral building, *Polypi.* * It consists simply of a slender tube-like sack attached at one end to some solid object in the water, such as a stone, twig, or floating piece of wood, and having at the other extremity a small opening surrounded with several thread-like tentacula. These parts constitute the whole animal. There are no viscera of any kind, heart, lungs, blood vessels, or nerves within.—The animal is simply an empty sack, with a mouth. Into this mouth is drawn by the tentacula, various microscopic animalculæ, which happen unluckily to venture within their reach. Once within, they are soon digested into a liquid which is absorbed into the walls of the sack, and contribute to the nourishment and growth of the Hydra. The young seem to grow of their own accord out of the sides of the parent. They " appear at first as knob-like protuberances from the body of the Hydra, they gradually increase in size and come to present something of the form of the parent; an aperture is then seen at the free extremity, and around this, tentacula begin to sprout. The young during their growth are like so many buds upon the sides of the original stock, and the hollow part of each communicates with the internal cavity of the old one, from which they are fed. Even after the tentacula of the bud are sufficiently developed to enable it to obtain food for itself, the communication remains open for a time, as appears from the fact that either of the stomachs is distended when the other is fed. As the bud, however, advances towards completeness, the aperture contracts, and is at last obliterated; the stock itself gradually becomes more slender, and is at last broken by the slightest effort of either the old or the young Hydra, and the latter is then set free, and after roaming through the water for a time attaches itself to a twig or stone and commences life and the rearing of a family on its own account. There is no distinction of sexes, and what is more astonishing the Hydra may be cut into pieces and each minute fragment will grow into a new and perfect Hydra, and produce young. †

The Hydra is not a true coral animal, and has no hard parts. The reef building animals are marine, and a little more complicated in structure. If we were to imagine a small additional sack hanging down inside of the

* *Polyp,* plural, *Polypi.* The general designation of coral animals, from the Greek, (*polus,*) many, and (*pous,*) foot; the many tentacles of the Polyp being at first considered the feet.

† See Dr. Carpenter's Principles of Comparative Physiology, HYDRA, in index.

Hydra from the mouth, we should have an approximate idea of the structure of what is improperly called the coral insect. The bodies of most of these consist of two sacks, one within the other, the mouth communicating only with the smaller or inner sack. The space within, all round between the two sacks, is divided by a number of upright partitions which extend from without inwards. As in the Hydra, there are no viscera. The food is captured by the tentacula, and drawn into the stomach through the mouth passing first into the inner sack where it is digested. The undigested portions are then thrown out through the mouth, but the liquid extracted from the food is discharged through an aperture at the bottom of the inner sack and flows into the space between the two, whence it is absorbed into the general structure of the animal, as in the Hydra.

The above explains the leading features of the structure of those Polypi, whose secretions form large areas of submarine rock in many of the warmer regions of the ocean. Those who wish to pursue the subject farther, and we strongly recommend all who feel any interest in the wondrous works of the Creator to do so, must consult other books where these matters are treated of more in detail.

The Hydra, and a multitude of the other Polypi, are entirely soft, and do not form coral; but in great many other genera, within the substance of the outer wall or sack, and also of the radiating partitions, various stony elements are secreted, and an internal hard skeleton is formed. As the animal is attached to the rock, so is its skeleton, and as when one generation dies another grows upon its remains, so the reef must grow until it reaches the surface of the water, and thus those obstructions to the navigation so common in many of the seas are produced.

The corals grow upon the bottom of the ocean in a great variety of forms. Some of them spread over the rock in an incrusting layer, consisting of myraids of the Polypi, connected together and forming a continuous thin sheet over the bottom everywhere alive with their minute flower-like forms. Others sprout upward in the shape of shrubs or small trees, with stout round branches, each formed of thousands of the Polypi: while some species form little rounded hillocks, like the dome of a Turkish Mosque, and in size from two or three inches to twenty feet in diameter. The Polyps spread over these with their circles of tentacula, appear like so many individual flowers, and they are moreover so radiant with colours, that, according to the descriptions of travellers, no scene upon earth is more beautiful than one of those submarine gardens. *

* Among them, says Professor Dana, are flowers of all hues and sizes. The Actiniæ may be well called the Asters, Carnations, and Anemonies of the submarine garden; the Tubipores and Alcyonia, form literally its pink beds; the Gorgoniæ and Melitæos, are its flowering twigs; the Madrepores, its plants and shrubbery; and Astrœas often form domes amid the grove, a dozen feet or more in diameter, embellished with green or purple blossoms which stud the surface like gems; while other hemispheres of Meandrina appear as if enveloped in a net-work of flowering vines.

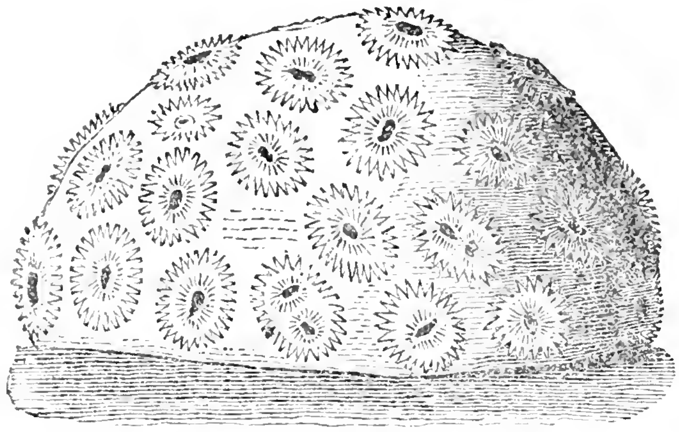


Fig. 2, *Astrea purpurea*, (DANA.)

Figure 2 will give an idea upon a small scale of a dome-shaped coral. This figure is copied from Silliman's American Journal of Science, New Series, vol. 3, page 3. In that volume of the Journal there are several fine articles on Corals, written by Professor James Dana, who spent several years among the Coral Islands of the Pacific and other seas, and whose magnificent work upon the ZOOPHYTES * is considered to be one of the best contributions ever made to any department of Natural History. Mr. Dana says in one of the articles in question :—"Many of the various shapes which these zoophytes assume, are familiarly known. Madrepore shrubs and trees, and the sea-fan and other Gorgoniæ from the West and East Indies, are common in collections.—The hemispheres of *brain-coral* (Meandrina,) and also of *star-coral* (Astræa,) are often met with. It is very generally supposed that these are by far the most frequent, if not the only shapes presented ; but, on the contrary, the varieties are extremely numerous, as we have already intimated. Some species grow up in the form of large leaves rolled around one another like an open cabbage, and *cabbage-coral* would be no inapt designation for such species. Another foliated kind consists of leaves more crisped and of more delicate texture, irregularly clustered ;—*lettuce-coral* would be a significant name. Each leaf has a surface covered with polyp-flowers, and was formed by the growth and secretion of these polyps. Clustered leaves of the acanthus and oak, are at once called to mind by other species ; a sprouting asparagus-bed by others. The mushroom is here imitated in very many of its fantastic shapes, and other fungi, with mosses and lichens, add to the variety.

"Vases of Madrepores are common about the reefs of the Pacific.—They stand on a cylindrical base, which is enveloped in flowers when alive, and consist of a network of branches and branchlets, spreading gracefully from a centre, covered above with crowded sprigs of tinted polyps. The vases in the collections of the Expedition, at Washington, will bear out this description, although but the lifeless coral.

"The domes of Astræas are of perfect symmetry, and often grow to a diameter of ten or twelve feet without a blemish. The ruder hillocks of Porites are sometimes twenty feet across. Besides these, we might describe columns, Hercules' clubs, and various strange shapes which are like nothing but themselves.

"It is an enquiry of much interest, how these various forms proceed from the budding process.

* *Zoophyte*, from the Greek, (*Zoon*,) an animal, and (*Phyton*,) a plant.—The word is used with various limitations of meaning by different authors, but seems to be synonymous with Polyp.

"Buds grow from some part of the parent, generally appearing first as a small protuberance upon its side, and afterwards perfecting into a complete young animal with its mouth and tentacles. Each of the compound zoophytes above alluded to, commenced with a single polyp and was thus formed; bud followed bud, and so the germ grew up into the coral tree or dome. Calculating the number of polyps that are united in a single Astræa dome, twelve feet in diameter, each covering a square half inch,—we find it exceeding one hundred thousand; and in a Porites, of the same dimensions, in which the animals are under a line in breadth, the number exceeds five and a half millions; there are here, consequently, five and a half millions of mouths and stomachs to a single zoophyte, contributing together to the growth of the mass, by eating, and growing, and budding, and connected with one another by their lateral tissues and an imperfect cellular or lacunal communication. There is hence every variety, as to number, among compound zoophytes, down to the simple polyp, which never buds at all, and has, for its corallum, a simple calicle,—it may be a tiny goblet, with a stellate cell, as in the Cyathina—a cylindrical cup, as in some Dendrophyllias—or a radiated disk, as in the Fungias and Cyclolites."

After treating of the various modes of growth which result in the production of trees, vases, domes, or incrusting sheets of coral, he says: "There is much to surprise and interest us in tracing out the simple causes of results so remarkable. The small polyp, incapable even of extending its arms without a drop of water to inject them, is enabled, by means of a simple secretion in its texture, in connexion with the process of budding, to rise from the rock and spread wide its branches, or erect, with solid masonry, the coral domes, in defiance of the waves that break over them. The microscopic germ of a Gorgonia developes a polyp barely visible to the naked eye, which has the power of producing a secretion from its base. The polyp buds, and finally the growing shrub is covered with branches and branchlets, many a mere thread in thickness, which stand and wave unhurt in the agitated waters. The same secretions fix it to its support, so strongly, that even the rock comes away before the zoophyte will break from its attachment. Tens of thousands of polyps cover the branches, like so many flowers, spreading their tinted petals in the genial sunshine, and quiet seas, but withdrawing when the clouds betoken a storm.

"Excelsior," is the grave motto of the zoophyte. Ever upward, they continue growing and elongating, although death is at work below, with as rapid progress. A beautiful provision protects the branching coral-tree—often the work of ages—from being destroyed by the dissolving waters, when exposed, on the death and removal of the polyps. Certain minute incrusting corals—the Bryozoa and Sertularidæ, together with Nullipores—make the surface their resting place, as soon as it is laid bare, and go on spreading and covering the dead trunk, and so prevent the wearing action of the sea. The Madrepore may thus continue to enlarge beyond its adult size; the Caryophyllia may multiply almost endlessly its cylindrical branchings, although the living animal but tips the extremities of each: for protection is given at once, when needed, and the polyps die, only to leave the surface to other forms of life, more varied and no less strange.

"Finally, the coral becomes subservient to a still higher purpose than the support of polyps and nullipores. The debris, produced by the waves over a reef, settles into the many crevices among the dead trunks, and fills up the intervals, often large, between the scattered coral-patches; and, by this combined action of living growth and detritus accumulations, a solid rocky basement is formed, and kept in constant increase. In this way the coral reef gradually nears the surface, and finally becomes the foundation of one of the fairest of

"The sea-girt isles,
That, like to rich and various gems, inlay
The unadorned bosom of the deep;"

the coral polyps now yield place to the flowers and groves of the land, which fulfil their end in promoting the comfort and happiness of man."

After the above somewhat extended remarks and quotations, we shall now proceed to examine some of the fossil corals that may be collected more or less abundantly from those rocks in Canada which in remote ages were reefs at the bottom of the ocean, probably as brilliant in their floral hues as those of the Pacific. The first of these we shall mention belongs to the family of the *Cyathophyllinæ* * or cup shaped corals, and is somewhat common in certain localities of the Trenton Limestone.

Fig. 3.

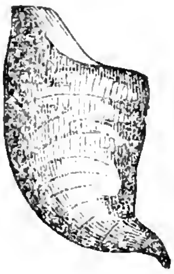


Fig. 4.

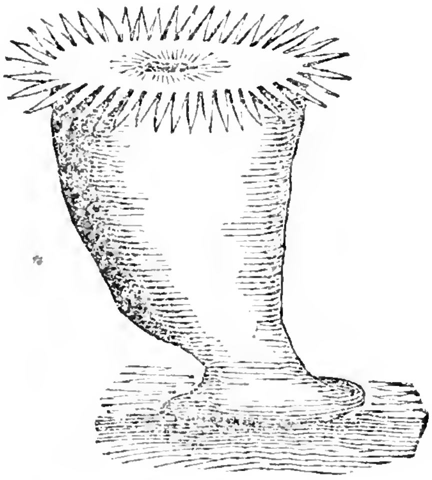


Fig. 5.

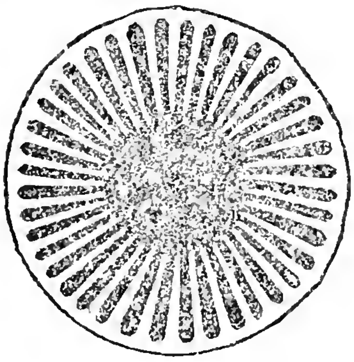


Fig. 6.

Figs. 3 and 4.—*Streptelasma corniculum, as it is usually seen in the fossil state in the Trenton Limestone.*

Fig. 5.—*An ideal figure of a living streptelasma.*

Fig. 6.—*A section across one of those fossils near the top.*

In the figure given of the dome-shaped *Astræa*, (Fig. 1, page 119,) it will be seen that the specimen from which the drawing was made, consisted of a number of Polypi growing together in one mass, but in the species now

* From the Greek "*Kuathos*," a cup.

under consideration, each individual grew separately and unconnected with any other. Fig. 5 shews what we suppose was the appearance presented by one of these Polypi when growing on the bottom of the ocean. Outside, it probably consisted of a soft fleshy covering, which attached itself by a spreading base to the bottom. This soft integument also spread over the top and was perforated in the centre by a small opening, which was the mouth.—Around this was the circle of tentacles; from the mouth there hung down into the interior a small sack, which was the stomach; between this and the exterior there were a number of thin partitions radiating in the manner shewn in Fig. 6. These partitions and the inner portions of the exterior envelope or sack became solidified during the life of the animal, in the same manner that the bones of a quadruped are formed within the exterior soft covering of flesh. All those corals which are to be seen in the cabinets of the curious, were, when alive, covered with a thin gelatinous layer of fleshy substance. After death this decays, and only the solid part, or the coral, properly so called remains, preserving the shape of a branching twig, a dome shaped mass, or a cup, according to the species. The corals of this extinct genus *Streptelasma* are of the latter form, and partly hollow within, though usually found filled with limestone. Good empty specimens shew the radiating partitions projecting inward and meeting in the centre at the bottom of the cavity. The partitions or lamellæ, as they are called, extend up and down, and are more numerous above than below.

With the above explanations it will perhaps not be difficult for the student of Canadian Geology to understand the following concise description of the genus. It will be recollected that a family of animals, or fossils, contains a number of genera, and each genus, one or more species.

GENUS STREPTELASMA, (Hall.)

Generic Characters.—Corallum, simple, turbinate; radiating lamellæ, meeting in the centre at the bottom of the cup, where they are more or less twisted; no transverse diaphragms.

The generic name is from the Greek (*Streptos,*) twisted: and (*plasma,*) lamellæ; corallum means simply "coral;" turbinate, is top-shaped or conical. This genus is also called (*Petraia*) by many European Geologists, from the Greek (*Petraion,*) stony, or living among stones.

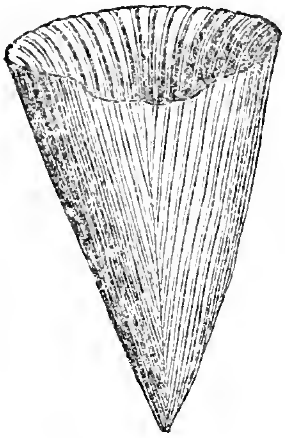
There are several species of this genus (*Streptelasma*) in the Trenton and other limestones of Canada. They usually have the appearance of short curved petrified horns of some ruminating animal. They are striated upon the outside from the top to the bottom, each of the striæ marking the position of one of the lamellæ inside of the cup. The following are the species that most frequently occur in Canada:—

Streptelasma corniculum, (Hall.)

This species is generally from an inch to one inch and three quarters in length, considerably curved and marked by several obscure wrinkles or folds, between which again are many finer ones that encircle the cup. These are only visible in perfect specimens. Those which are worn on the outside do not shew them. In the specimens in our collection which we believe to belong to this species, there are from 60 to 90 lamellæ to be seen on the outside of the cup at the margin. In those which are empty the cavity once occupied by the inner sack mentioned in the preceeding pages, extends downward from one fourth to one third of the length of the fossil. On the outside the lamellæ are seen to branch from the sides of a line running from the top to the bottom along the convex, curved side, and again from two other similar lines at the sides.

This species occurs in the Trenton Limestone, and is somewhat common in the rock at the Barrack Hill at the city of Ottawa. The specific name (*corniculum*) is from the Latin, "a little horn."

STREPTELASMA PROFUNDA, (Hall.)



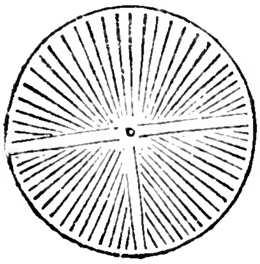
In this species the cup is very little, or not at all curved. The length is about an inch and a half in full grown specimens, and the cavity within extends sometimes nearly to the bottom, hence the name (*profunda*,) "profound" or "deep." There are about 74 lamellæ in specimens of the size represented in Fig. 7. They are usually small, and large alternately. The small ones are those newly developed, and not full grown.

This species occurs in the Black River and Bird's Eye Limestones, at the base of the Trenton.

Fig. 7.—*Streptelasma profunda.*

In addition to the above there are several other species in the Trenton Limestone which we shall endeavour to figure hereafter. They are *S. crassa* with about 50 thick coarse lamellæ, *S. multilamellosa* with about 120 lamellæ, and *S. parvula* with only about 30. The latter is very small, and all resemble very much *S. corniculm.* *Crassa*, thick; *multilamellosa*, "many lamellæ;" and *parvula*, small.

The mode of growth of these corals appears to have been as follows:—At first they consisted of a mere point attached to the rock, when the cup commenced to form there were only four partitions or lamellæ, as it increased others were added, three of the original ones continuing to grow, and the fourth being undeveloped. In good empty specimens of *S. profunda* the three large primary lamellæ are very conspicuous above the others on the inside of the cup, and on the outside their position is marked by three upright seams extending from the top to the bottom, and from each side of which the newer lamellæ may be seen branching away. One of those is seen in the front of Figure 7.



These cup shaped corals with the four primary lamellæ commenced their existence in the seas of the Lower Silurian age, but became extinct in the Permian. To this important fact we shall return hereafter.

Fig. 8.—*Interior of* (*S. profunda*,) *shewing the three large primary lamellæ.*

Genus Columnaria, (Goldfuss.)

A very abundant family of fossil corals have a honey-combed structure, consisting of a great number of angular tubes growing together, each tube being the cup or cell of a single polyp. The *Astræa* shewn in figure 2 is one of those composite forms. and when dead is covered with numerous star-like openings. The rays of the stars in each of those tubes of the *Astræa* correspond to the lamellæ of the genus *Streptelasma*. If we could imagine a number of these latter crowded together in one mass, they would constitute a star covered dome, something like the *Astræa*. In the Lower Silurian rocks one of the most common of the honey-combed corals is the *columnaria alveolata*. The following is a description of the genus compiled from several authors.

Generic Characters.—Corallum forming large masses, often of a hemispheric form, cells, polygonal, radiating lamellæ, rudimentary, or but little developed; transverse, diaphragms, horizontal, and numerous.

The generic name is from the Latin, (*Columna*,) a column having allusion to the numerous column-shaped tubes of which the masses of the coral are composed. The transverse diaphragms are the little plates or floors which extend across the tubes, dividing each into so many stories, one above the other. There is one species of this genus known in Canada, and it is very common in some localities of the Black River Limestone. It is the following:

Columnaria alveolata, (Goldfuss.)

This species is thus described by Professor Hall:—" A hemispherical or irregularly massive coral, consisting of radiating parallel or diverging tubes; tubes hexagonal, (or varying from 5 to 7 sided,) striated longitudinally, crossed by dissepiments, (diaphragms,) with vertical radiating lamellæ; no communicating pores.

Fig. 9.

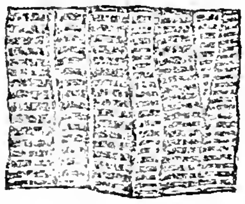


Fig. 10.

Fig. 9.—*Is a small mass of (Columnaria alveolata,) shewing the honey-combed appearance of the exterior of the fossil.*

Fig. 10.—*Shews the portion of the surface of a mass which has been split open in the direction of the length of the tubes. Each tube is seen to be divided into a number of chambers by the transverse diaphragms.*

When the tubes of this coral are well preserved and empty, the interior is seen to be striated the whole length of the tube, the elevated lines being the rudiments of radiating lamellæ. The coral is sometimes seen in masses three feet in diameter, and when these are split open in a direction from the top to the bottom, the tubes are seen to radiate from a narrow space in the centre at the base, curving gracefully outwards. Each one of the tubes was the residence, or rather the hard external skeleton of a single Polyp, and when these were alive, no doubt the whole surface of the mass was covered with animal flowers, as in the Astræa. The seas of the ancient Silurian epoch were perhaps quite as gorgeous as the coral reefs in the southern climes of the present day.

Columnaria alveolata is confined to the Black River Limestone which lies just below the Trenton Limestone. Fine specimens may be collected in the quarry, where materials are now being procured for the Chatts Canal on the Ottawa.

The *Favosites Niagarensis* mentioned in Article 6, pages 57 and 60, of this journal, and also *Favosites Gothlandica*, noticed in the quotation from Sir Charles Lyell, at the commencement of the present article, very much resemble this species externally. The difference is in the internal structure, the walls of the tubes of *Favosites* being perforated by numerous small circular pores, and *Columnaria* unperforated. *Alveolata* appears to have been derived from the Latin, (*Alveare*,) a bee-hive, or (*Alveolus*,) the holes in which teeth are placed.

Another genus of corals composed of tubes most prolific in the Lower Silurian rocks of Canada, is *Chœtetes*. Some of the strata in the Trenton Limestone appear to be composed almost altogether of one species of it in a fragmentary state. The tubes are exceedingly small, and they differ from *Astræa* and *Columnaria* in presenting no traces of radiating lamellæ. The following is a description of the genus :—

Genus Chœtetes, (Fischer.)

Generic Characters.—Corallum usually forming cylindrical branches or hemispheric, or irregular masses composed of numerous long slender polygonal tubes with transverse diaphragms, but no pores or radiating partitions.

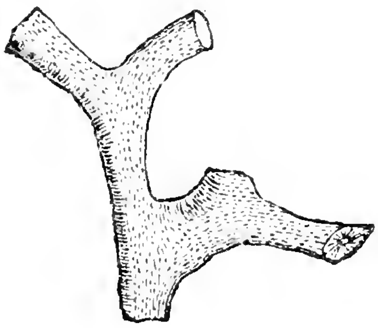


Fig. 11.

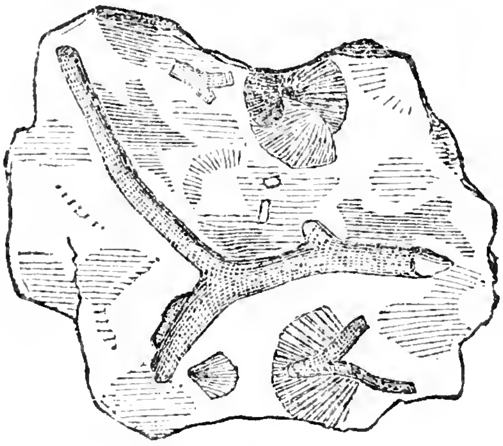


Fig. 12.

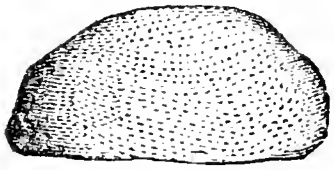


Fig. 13.

Figs. 11, 12, and 13.—*Different forms of Chœtetes Lycoperdon.*

The above figures shew the most common forms of this coral. Fig. 12

is the branched variety. It is often seen on the surfaces of the strata of limestone, partly imbedded in the rock, and resembling small broken twigs of trees. Often layers of shale are met with between the strata, packed full of these short stems. They are from one-fourth to one-half of an inch in diameter. The tubes are exceedingly slender and hair-like, seldom exceeding one-fortieth of an inch in diameter. They are so small that it requires close examination of the surface of the coral to detect their presence. In the branched variety they originate in the centre of the stem, and radiate outward and upward. When such specimens are split open, this internal arrangement of the tubes can be well seen. The other variety is usually seen in small hemispheric or button-shaped masses from half an inch to three inches in diameter. Often they are globular, with a rounded concavity in the bottom. Sometimes they are found with a projection below, giving them the appearance of the stopper of a bottle, with a wide mushroom-shaped top. They also occur nearly flat, or with the upper surface no more convex than an ordinary watch glass. The base of those flat specimens is wrinkled concentrically. These masses are formed of the same long slender tubes as those which constitute the branched variety.

More than one hundred years ago, when geology was unknown, a Swedish traveller, PETER KALM, a Professor in the University of Abo, in Swedish Finland, visited Canada, and in his narrative, gives the following account of the Fossils he saw in the Limestone at Fort St. Frederic, or Crown Point, on Lake Champlain :—

"The mountains on which Fort St. Frederic is built, as likewise those on which the above kinds of stones are found, consisted generally of a deep black limestone, lying in lamellæ as slates do, and it might be called a kind of slates, which can be turned into quicklime by fire. This limestone is quite black in the inside, and, when broken, appears to be of an exceeding fine texture. There are some grains of a dark spar scattered in it, which, together with some other inequalities, form veins in it. The strata which lie uppermost in the mountains consist of a grey limestone, which is seemingly no more than a variety of the preceding. The black limestone is constantly found filled with petrifactions of all kinds, and chiefly the following :

"*Pectinites*, or petrified *Ostreæ Pectines*. These petrified shells were more abundant than any others that have been found here, and sometimes whole strata are met with, consisting merely of a quantity of shells of this sort, grown together. They are generally small, never exceeding an inch and a half in length. They are found in two different states of petrifaction ; one shews always the impressions of the elevated and hollow surfaces of the shells, without any vestige of the shells themselves. In the other appears the real shell sticking in the stone, and by its light colour is easily distinguishable from the stone. Both these kinds are plentiful in the stone ; however, the impressions are more in number than the real shells. Some of the shells are very elevated, especially in the middle, where they form as it were a hump ; others again are depressed in the middle ; but in most of them the outward surface is remarkably elevated. The furrows always run longitudinally, or from the top, diverging to the margin.

"*Petrified Cornua Ammonis.* These are likewise frequently found, but not equal to the former in number: like the *pectinitæ*, they are found really petrified, and in impressions; amongst them were some petrified snails.—Some of these *Cornua Ammonis* were remarkably big, and I do not remember seeing their equals, for they measured above two feet in diameter.

"Different kinds of corals could be plainly seen in, and separated from, the stone in which they lay. Some were white and ramose, or *Lithophytes*, others were starry corals, or *Madrepores*; the latter were rather scarce.

"I must give the name of *Stone-balls* to a kind of stones foreign to me, which are found in great plenty in some of the rock-stone. They were globular, one half of them projecting generally above the rock, and the other remaining in it. They consist of nearly parallel fibres, which arise from the bottom as from a center, and spread over the surface of the ball and have a grey colour. The outside of the balls is smooth, but has a number of small pores, which externally appear to be covered with a pale grey crust. They are from an inch to an inch and a half in diameter." *

The *Stone-balls* which Kalm saw were most likely the puff-ball variety of *Chatetes Lycoperdon*, while the branched corals of which he speaks were the other kind. Kalm visited North America in 1749. He was sent to America by the Royal Academy of Sciences at *Stockholm*, "to make such observations and collections of seeds and plants as would improve *Swedish* husbandry, gardening, manufactures, arts, and sciences." His book is full of remarks upon things in this country which are not even yet much observed here.

Chætetes Lycoperdon is the most abundant of all the Lower Silurian corals. It ranges from the chazy limestone upwards to the Niagara group, and is found in England, Ireland, Sweden, Russia, and in fact in all countries where the Silurian rocks are to be seen. In Canada, sometimes thick beds of limestone are often met with, composed almost altogether of the fragments of this coral.

Chatetes appears to be from the Greek, *Chaite*, hair, and the genus was so called, probably from the hair-like smallness of the tubes. *Lycoperdon*, (a puff ball.) By many Geologists this genus is called Stenopora. *Stenopora* is from the Greek; *Stenos*, narrow or small; and *poros*, a passage or pore.

Fig. 14.

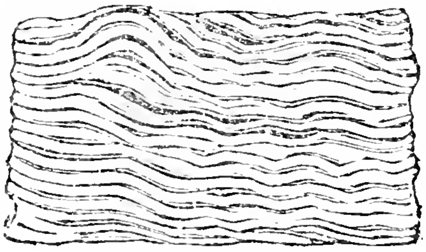


Fig. 15.

Figs 12 and 13.—*Stromatocerium rugosum*, (Hall.)

Concerning the true nature of this fossil there appears yet to be some doubt. It consists of numerous broad wrinkled leaves, penetrating the rock with their edges upward. They are generally bent in a half circle, as shewn

* Kalm's Travels, vol. 2, page 197.

in Fig. 12, the diameter of the masses being from one to twelve or more inches. It is found abundantly in the Black River Limestone, generally accompanied by *Columnaria alveolata*, but as its internal structure has not yet been explained, the family of coral to which it may belong cannot be pointed out. The generic name is from *stroma*, a layer or lamina; and *cerion*, a honey-comb.

The above five species of fossil corals are those most commonly met with in the Lower Silurian rocks of Canada. There are a few other species not so abundant, which will be described hereafter.

On turning back to the classification of the animal kingdom given on page 31, it will be seen that the department RADIATA is divided into three classes Sea-urchins, Jelly-fishes, and Polyps. The latter are also subdivided into three orders, *Hydroids*, *Actinoids*, and *Rhizopods*. The Trenton Limestone corals are all *Actinoids*, with the exception of the last one described, *Stromatocerium rugosum*, the true position of which has not yet been ascertained. From the descriptions above given, it is not difficult to understand why the corals should be called radiated animals.

ARTICLE XVIII.—*On some of the technical terms used in the description of Fossil Shells.*

The language used in the science of palæontology appears to the beginner unintelligible, and devoid of interest, but when understood, it will be found full of meaning and exceedingly convenient. In the description of fossil shells, although at first sight one is liable to be impressed with the idea that there are a great many hard words to be learned yet upon a further acquaintance with the subject, this difficulty will appear to have been overrated. There are in fact in this extensive branch of Natural History only a few technical terms in use, and most of these may be comprehended after a few minutes study.

It is not necessary in this work to enter into a detailed interpretation of such words as hemispheric, cylindrical, tumid, gibbous, quadrate, subquadrate, rhomboidal, sub-romboidal, globose, or sub-globose. Nearly all general readers are either already acquainted with the meaning of these, or by reflecting a moment may arrive at their import, or by referring to any good dictionary of the English language, ascertain the sense in which they are used. It may be proper to state that the prefix "sub," is used to denote an inferior degree, as in the words quadrate, approaching in form to the square and sub-quadrate, not so near the square as quadrate. The possession of a good dictionary and the habit of referring to it will be found sufficient for the greater number of cases. Unless, however, the reader is also a collector, the explanations will be of no practical value. Specimens may be collected from almost every quarry or exposure of rock in the settled portions of this country. We would strongly recommend some attention to this pursuit during those leisure hours of which most persons have more or less.

On examining one of the common clam-shells, as they are popularly called, of our rivers, it will be seen that the hard parts of the animal consist of two pieces joined together at the back, where each opens upon the other like a door upon its hinges. These shells are concave, so that when closed there is a considerable space within, occupied by the soft parts of the animal. The two shells are called valves, the joint where they are connected together is the hinge, and the small protuberances on the edge of the hinge, the teeth. Similar terms are used in describing fossil shells.

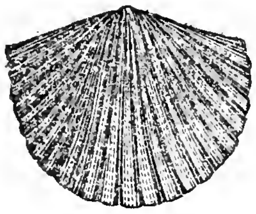


Fig. 1.

Fig. 2.

Fig. 3.

In the Brachiopoda, such as the *Lingula, Orthis, Spirifer, Leptena, Strophomena,* and others, there are two valves, and it has been ascertained by the dissection of specimens of those species at present living in the oceans, that one of these valves is placed upon the back and the other on the ventral side of the animal. Hence they are called dorsal and ventral valves. Fig. 1 shews the ventral valve of *Orthis tricenaria,* a Trenton Limestone species, very abundant in that rock at the lower end of the Allumette Island on the Ottawa. Fig. 2 is a dorsal view of the same specimen; in this figure it will be observed that the dorsal valve is shorter than the other. It extends only to the straight line across the figure near the top. The broad triangular space above the line is a portion of the ventral valve. Fig. 3 is a side view of a specimen shewing how the ventral valve projects above the other in a sharp hook-like termination, which is called the beak. Both valves have a beak, but that of the ventral is almost always the largest, and projects the highest. The hinge line is simply the hinge portion of the shells.

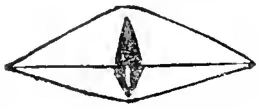


Fig. 4.

Fig. 5.

Fig. 4 is an end view of *Orthis tricenaria* looking at the hinge, the ventral valve being uppermost. The valves are each terminated by a flat space, as if they had been cut off with a knife. These constitute what is called the "*cardinal area,*" "*hinge area,*" or simply "*the area.*" The area in the genus Orthis is penetrated in the centre by an angular aperture, shewn in fig. 4, by the lozenge-shaped black space in the centre. Through this aperture it is supposed the pedicle passed, by which the animal was attached to the bottom of the sea. It is called the "*foramen,*" or "*fissure.*" It consists of a triangular notch in each valve, deepest in the ventral valve.

Fig. 5 is the end of a dorsal valve of the same species, the ventral being removed to shew some of the internal appendages. The two projecting points are supposed to have been the supports of the fleshy arms which constitute the distinguishing feature in the organization of the Brachiopoda. The arms were long, slender, fleshy, string-like appendages, fringed with rows of hair-like tentacula, and used by the animal for capturing its food. These supports of the arms are longer in *Orthis tricenaria* than in any other species of this genus we have seen. They can only be observed, however, in well preserved specimens. They are sometimes called *cardinal teeth*, or *dental laminæ*. They might be termed *brachial processes*. Between these is seen a third small triangular projection. This is situated in the fissure of the dorsal valve, and is called the *rostral tooth*, or *boss*. It is not however a tooth in the sense in which that term is used in Conchology, but simply a shelly process or projection to which a muscle was attached for the purpose of opening the valves. This is the opinion of the most modern authors.

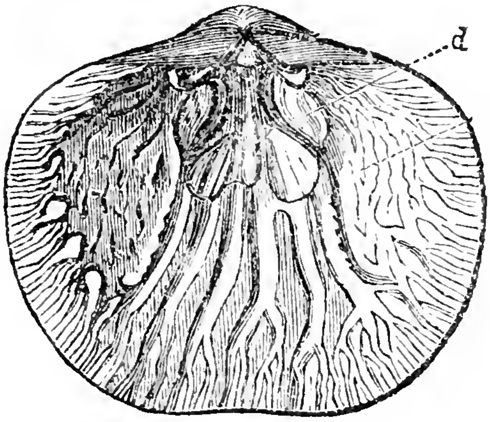


Fig. 6.

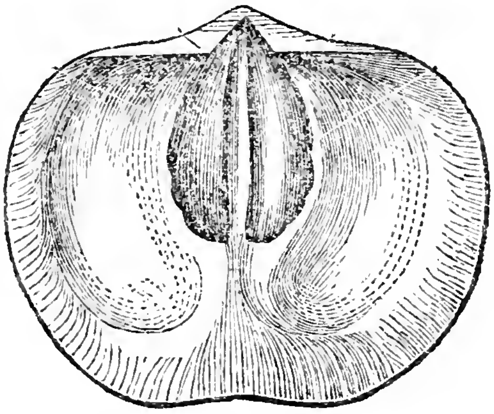


Fig. 7.

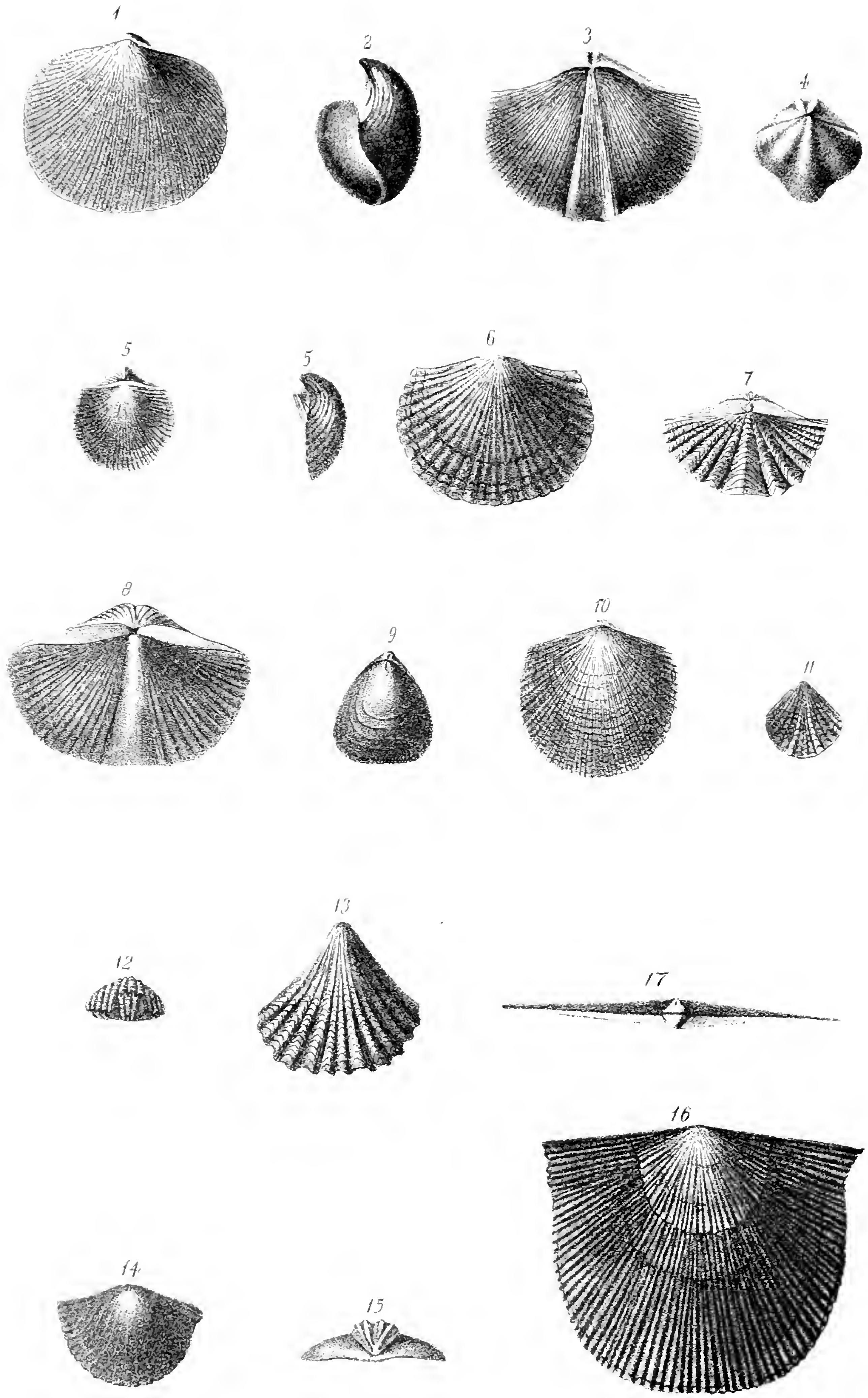
Figs. 6 and 7 shew the interiors of the dorsal and ventral valves of another species of Orthis. In these the cardinal areas, triangular foramen, cardinal teeth, rostral tooth, &c., may be recognised.

Fig. 6 is the dorsal valve, and it has near its upper portion four oval scars or depressions two on each side. The letter d points to the uppermost on the right. The other is immediately below it. These two and the two on the other side corresponding to them are *muscular impressions*. They mark the positions of the bases of four muscules which were fastened in these pits and extended to the other valve. Their office was to close the valves, hence they are called *adductors*. In the ventral value, Fig. 7, two long oval scars are also to be seen. These are the "*Cardinal muscular impressions.*" The muscles inserted in these were attached at the other extremity to the "*cardinal process*, or *tooth*," in the fissure of the dorsal valve, and serve to open the shell. The branched root-like marking in the dorsal valve are the "*pallial*" impressions.

It is not often that specimens can be procured which will exhibit all these various portions of the internal structure of the Brachiopoda, and it is not necessary therefore to proceed further at present with their examination. Sufficient has been pointed out for the general purposes of this work.

The genera are distinguished not only by their outward form, but also

Pl. 2



FOSSILS OF THE NIAGARA AND CLINTON GROUPS.

J. H. Bufford's Lith. Boston.

by their internal structure, such as the position of the muscular impressions, the form of the processes for the support of the arms, and other characters which will be explained hereafter.

It is a good plan for the student to commence with learning to recognize species by the description given of their external form, since it is most usually in a condition in which the internal characters cannot be observed that these fossils are found. The insides of many species have never yet been seen, and in collecting specimens particular care should be taken of all those which exhibit the interior surface of the shell. Should any be found of those species whose internal structure has not yet been ascertained, they would be highly prized.

In the next article we shall give the characters of several of the genera, together with descriptions of a number of the species which occur in the Upper Silurian rocks, and it will be there seen how and to what extent the technical terms above explained may be made available.

ARTICLE XIX.—*On some of the Fossil Shells of the Niagara and Clinton Formations.*

Having in the last article explained a few of the technical terms used in palæontology we shall now proceed to describe several of the genera of fossil shells, first reminding the reader that these descriptions will be of little service unless to those who collect specimens. In Natural History and Geology physical action is necessary, in addition to reading and reflection. As all science consists in the understanding and explication of the operations of the laws of nature, so he that would comprehend the mysteries of any one department should observe personally, otherwise his knowledge must be merely theoretical. He will lose the enjoyments of learning, and only familiarize himself with the fruitless difficulties. An eminent Naturalist has said :—

" Our object in examining the stone, the rock, the lichen, the moss, the flower, the fruit, the insect, the bird, or the quadruped, is to exercise our faculties by learning how beautifully, and with what wisdom all things have been constructed, how wonderfully they are formed with relation to each other, and how manifestly they display a power of which we could form no conception were we not to attend to its working as exhibited by them. It is true we cannot fully comprehend the complicated relations of the most common objects, much less understand the ordination of the universe, or even of our own world; but we labour in hope, we are studying, some of us, no doubt very superficially—others more profoundly—the works of the Deity, and the more progress we make the more we glorify Him by an intelligent, not a vague admiration. There are some who aim at the knowledge of general laws, some who seek simple facts. Both parties will find enough to engage their faculties, and neither will do the work of the other sufficiently. There is no reason why one should despise the other. Contempt of anything but vice, indicates an unsound mind, a defective judgement, an ignorance of the relations which men have to each other, and to their Creator, an undue self-estimation and a contempt of the rights of other men. He who measures the orbit of a comet has not, therefore, higher faculties than he who examines the cytoblast of a fungus; and there is far more to be seen by us in a beetle than in a planet—upon that granite mountain opposite, at the distance of nine or ten miles, than in the sun and the moon and the stars." *

In Geology some of the principal truths that break upon the mind from actual examination of the various formations of rock are, the amazing antiquity of the earth, the enormous revolutions that have taken place on its surface, the number and vastness of the convulsions to which it has been subjected, the strange forms of the races of animals by which it was inhabited during the many long and dark ages that rolled away previous to the creation of man, and most important of all the perception of the great fact that throughout all the prodigious changes and disturbances, all has been continually under the government and direction of some unseen power which is the same now as it was in the first ages. The operations of to-day may be traced back and connected link by link with those the most ancient, and thus it can be shewn that they constitute the work of but one mind; that amid all physical and vital subversions, there has been no change of rulers in nature. The creations and destructions of myriads of races of animated beings are events that have followed each other in a regular unbroken procession under the marshalling and direction of the same will. The same procession is still moving grandly onward, but how much of it there is still to go by science cannot tell. We can by simply going out into the fields and collecting and comparing specimens, ascertain the forms of those that have passed, but what these may be like which are yet to come is a problem reserved for the future.

The fossils intombed in the rocks of Canada, are the remains of the creatures that appeared in the commencement of the procession of life.—They may be called the old advance-guard. It is long since they passed, perished, and were buried. They are all of extinct species, most of them of extinct genera, while a very large proportion are even of orders that have now no representatives on earth. Those described in the following article are more or less abundant in those oceanic deposits of Western Canada, known as the Clinton and Niagara Groups, and although most of them are small in size, yet each forms a portion of the history of the world, and cannot be too carefully studied. They shew that when the great beds of rock were formed, over which the Niagara now rolls its waters, this country was beneath a vast sea, and that the life of that sea was totally different from that of the present oceans. If the mind can receive any benefit from musing over the history of fallen nations, surely something in the way of intellectual improvement must accrue from the study of the much mighier truths of the extermination of worlds of animated beings.

* Extract from the Natural History of Dee Side & Braemar; by the late Wm. MacGillivray, M.D.

GENUS ORTHIS, (Dalman.)

The shells of the Genus Orthis are usually small, few of them exceeding one inch in diameter ; they are generally nearly circular or quadrate, the hinge line is straight, and in most of the species shorter than the width of the shell. The valves are either equally or unequally convex, the ventral valve is often the longest, the beaks are more or less incurved, that of the ventral valve generally most prominent. The surface usually striated or ornamented by ridges radiating from the beak to the margin. Both valves have an *area*, and the foramen is partly excavated in both. The foramen of the dorsal valve is partly filled by a small cardinal tooth-like process, from which a small rounded ridge proceeds along the interior surface of the shell with two muscular impressions on each side, placed obliquely one above the other, (see fig. 6, page 130.) The muscular impressions in the ventral valve consist of two elongated depressions beneath the beak, usually divided by a small mesial ridge, (see fig. 7, page 130.) From each side of the foramen in the dorsal valve, two small, slender processes project, to which were, no doubt, fastened the free fleshy spiral arms. Many of the species have also a small tooth on each side of the foramen of the ventral valve.

The genus commenced to exist in the Lower Silurian epoch and continued until the carboniferous period, above which no specimen have been found.

GENUS STROPHOMENA, (Rafinesque.)

In this genus the shells have a very straight hinge line which is generally as wide or wider than the body of the specimens. They are semi-circular, semioval, or quadrate in form. One valve is convex, and the other concave on the outside. The two valves curve into each other ; sometimes it is the ventral and sometimes the dorsal, which is concave. The area occupies both valves ; it is largest, and partly covered by a thin shelly growth called the "deltidium," in the ventral valve. The beak of the ventral valve is either entire or perforated by a small circular aperture. The foramen in the dorsal valve is also partly occupied by a cardinal boss or process. The muscular impressions in the dorsal valve are not situated one above the other as in Orthis, but beside each other in a direction across the valve. Those in the ventral valve occupy a saucer-shaped cavity near the beak.

The genus appeared in the Lower Silurian and continued into the carboniferous epoch.

GENUS LEPTENA, (Dalman.)

The same as Strophomena, except that in the ventral valve the muscular impressions are not bordered by a ridge forming a saucer-shaped cavity, while in the dorsal valve they are large and long, extending from near the beak downwards two-thirds of the length of the shell.

The genus commenced in the Lower Silurian and continued to the latter part of the Lias period.

GENUS ATRYPA, (Dalman.)

The shells of the Genus Atrypa are often of a globular form, but sometimes elongated or sub-triangular, and most pointed at the beaks, which are small and incurved, or hook-shaped. The surface is sometimes smooth, but often ornamented with a number of ridges which radiate from the beak, (see figures 11 and 13.) The dorsal valve is the shortest, and the beak of the ventral usually curves over it. It has moreover an elevation or mesial fold in many species extending from the beak to the base, while the ventral valve has a corresponding depression or sinus. Within, the arms are coiled, forming two conical spires, the bases of which are towards the ventral and the spires in the hollow of the dorsal valve. In the interior of the dorsal valve the muscular impressions are separated by a small ridge extending from the beak downward, and in the ventral valve they are situated in a saucer-shaped depression under the beak. The beak is sometimes perforated by a small circular aperture.

This genus ranges from the Lower Silurian to the Devonian. Atrypa is from the Greek, (*a.*) without; and (*trupa,*) a perforation. Some of the species are however perforated.

GENUS SPIRIFER, (Sowerby.)

In this genus the ends of the spires are directed outwards towards the angles of the shell instead of into the hollow of the dorsal valve, as in Atrypa. These spires were first discovered in species of this genus, and hence the name from the Latin, (*Spira,*) a spire ; and *fero,* I bear.

Tbe spirifers have usually a long straight hinge line, a mesial fold on the dorsal, and a sinus in the ventral valve. They are either smooth or ornamented with radiating ridges. The angles at the ends of the hinge line are often extended, forming acute or rounded points or ears, as they are sometimes called. The beaks are either straight or curved. Both valves have an area often very small on the dorsal. Both have also a foramen, partly closed in the ventral valve.

The genus commences in the Lower Silurian and becomes extinct in the Frias.

The above are the principal characters of the five genera of Brachiopoda most abundant in species in the Silurian rocks. As the interiors of the shells are not often seen, we have thought it not necessary to incumber the reader with more lengthened descriptions. By comparing the figures of the species and collecting and examining specimens, the destinctions may be soon perceived. It should be remarked that the species described in this work, as belonging to the genus Atrypa, have not been yet proved to belong to that genus. Their internal characters are for the greater part unknown, and they have therefore been all classified by Professor Hall as Atrypæ for the present.

The following are the species from the Clinton and Niagara Groups, figured on plate 2 :—

Fig. 1, (*Orthis circulus,*) CLINTON GROUP.—This little shell is nearly circular, wider than high, and nearly equivalved. The surface is covered with numerous fine elevated lines or radiations. These curve outward as they proceed upward, and some of them run out on the hinge line. The area is narrow, and in length but little more than one-third of the width of the shell. The ventral valve is somewhat flattened near the base, and it is provided with a small beak which curves slightly over the area. The beak of the dorsal valve scarcely rises above the area line. There are a few fine concentric lines scarcely visible. The depression in the ventral valve is accompanied by a corresponding elevation on the dorsal valve.

Figs. 2 and 3, (*Spirifer radiatus*,) CLINTON AND NIAGARA GROUPS.—This is a fossil whose form is exceedingly variable, and is found in the Silurian rocks of both England and America. We shall therefore give the descriptions of authors in both countries, changing the names of the valves :

Professor Hall thus describes it :—" Shell variable in form, sub-triangular, rotund or subglobose, valves almost equally convex, the beak of the ventral valve more or less extended, and curving over the dorsal valve, hinge line often less than the width of the shell, the extremities being rounded, surface marked by fine close radiating striæ, mesial elevation and depression moderate, marked by the striæ as in other parts of the shell, dorsal area more or less exposed, and giving a very variable appearance to the shell, foramen narrow and long, often partially or entirely closed by a callosity, interior plates of ventral valve near together, and extending downwards within the limit of the mesial depression." *

Figure 2, shews a specimen with the ventral valve extended into a very high and curved beak, with a large area beneath. In Fig. 3, the beaks of the two valves are nearly of equal height, and so curved together that the area is nearly closed. Some of the specimens are twice the breadth of fig. 3, and with the angles more rounded. The mesial sinus, or depression, is always in the ventral, or larger valve, and the mesial elevation on the dorsal, or shorter valve. In fact this is their situation in nearly all the Brachiopoda. The following is Professor McCoy's description of the English specimens :—

" Transversely subrhomboidal gibbous, hinge-line slightly less than the width of the shell, cardinal angles obtusely rounded, ventral valve with a large incurved beak, and a wide deep rounded mesial hollow, extending from the apex to the front margin, which is abruptly raised into a deep quadrate sinus, sides gibbous, dorsal valve with a very prominent rotundato-quadrate mesial ridge, strongly defined from the beak to the sinus in the front margin, sides tumid, surface radiated with very fine, close, nearly equal, thread-like striæ, occasionally (23 in 3 lines, at 6 lines from the beak,) casts of ventral valve shew the slightly diverging slits of two extremely thick dental lamellæ. Average width, 1½ inch."

" Common in the Ludlow rock, Keeper's Lodge, Golden Grove, Llandeilo, Caermarthenshire." †

This fossil on account of its extremely variable form occasions much

* Palæontology of New York, vol. 2, page 66.

† Sedgewick & McCoy's British Palæozoic Fossils, page 195.

perplexity to amateurs, and can only be well understood by collecting and observing frequently numerous specimens, thus familiarizing the eye with its appearance, and ascertaining its gradations of form. It occurs in the Clinton group, and less commonly in the Niagara shale.

Fig. 4. *Atrypa congesta,* (Conrad,) CLINTON GROUP.—This species is nearly globular, or ovate, with a deep sinus which commences at the beak.—The shells are in most instances smooth, or only marked by concentric striæ. On each side of the sinus and mesial fold there is an additional fold, well shewn in the figure. The beak of the ventral valve is strongly incurved, or hooked over the dorsal valve. Professor Hall says " it is readily recognised in its usual appearance by its rotund and gibbous form. The variations are mainly due to the greater development of the carinæ on either side of the mesial fold and depression, which sometimes give the shell a different character, having three prominent folds on the dorsal and four on the ventral valve.—This change usually takes place in the older individuals, while the younger ones present only the mesial fold and depression. The specimens usually found are smooth, the striæ having been worn or dissolved away; but in perfect specimens they appear as fine raised thread-like lines."

The species is found in the Clinton group. One of the localities given by Professor Hall, is Flamborough Head, Canada West. *Congesta,* consisting of heaps.

Figs. 5 and 5, (*Orthis elegantula,*) CLINTON AND NIAGARA GROUPS.—This species much resembles *Orthis testudinaria* of the Lower Silurian rocks. The dorsal valve is nearly or quite flat. The ventral valve with a highly elevated beak curving over the area. The surface is covered with fine striæ. The size is about that of the figures.

It occurs in all the localities of the Niagara shale, and also in the Clinton group, and is abundant in Europe. Like its near relation *O. testidunaria,* it therefore has a wide geographical distribution.

Fig. 6, (*Orthis flabellulum,*) NIAGARA GROUP.—This fossil is thus described by Professor Hall :—" Shell semioval, hinge-line equal to the width of the shell, surface marked by twenty-four to thirty simple rounded plications, which are equal to the space between them, plications usually smooth, with the remains of concentric striæ crossing the depressions between, and rarely appearing on the elevations, a few strong imbricating lines of growth near the base, cardinal area usually narrow, and extending to the extremity of the hinge line."

" It is usually found so much flattened that the two valves appear to be equal. The ventral valve in perfect specimens is more convex than the dorsal. The foramen is broadly triangular with a thin sharp tooth in the centre and a stronger one on each side projecting into the centre, the muscular impression has a strong rounded ridge down the centre with a depression on each side, but the margins are not well defined. The interplication on the inside appear to be duplicate, or have a groove along the centre. In some specimens the plications on the interior extend but half-way to the beak ; while in others, that are apparently of the same species, they extend to the muscular impression."

This species occurs in the shale of the Niagara group. There is a species of the same name in the Lower Silurian rocks of England, and Prof. Hall considers these American specimens to constitute a variety of the English species. *Flabellulum*, Latin, a "little fan."

Fig. 7, *Spirifer sulcatus*, (Hisinger,) NIAGARA GROUP.—"Shell subtriangular and gibbous, cardinal line more or less extended, often pointed at the extremities, surface plicated, plications four to seven on each side of the mesial fold and sinus, crossed by strong imbricating lamellæ, and longitudinally marked by fine striæ which are interrupted by the edges of the lamellæ, mesial fold of the ventral valve very deep towards the base of the shell."

This species is readily distinguished by its roughly lamellate surface.—It is one of the most common forms in the Niagara Group. It is found also in the Silurian rocks of Europe. *Sulcatus*, Latin, furrowed.

Fig. 8, *Spirifer Niagarensis*, (Conrad,) NIAGARA GROUP.—The surface of this shell is marked by from twenty to thirty rounded plications, and these are also striated longitudinally by fine equal striæ. The mesial elevation consists of a single large fold, and the sinus of a corresponding depression.—It is a large shell when full grown, and both valves are about equally convex. The ventral valve has the beak elevated and incurved over the area, which is of medium size. The hinge line is usually shorter than the shell, and the ears are rounded. The young shells have only ten or twelve plications on their surfaces.

This fossil is typical of the Niagara Group, and is readily recognized by its rounded plications, which are evenly striated in a longitudinal direction. It occurs in the shale, and rarely in the limestone of the group.

Fig. 9, *Atrypa nitida*, (Hall,) NIAGARA GROUP.—"Shell ovoid, with the beaks more or less extended, surface smooth, or with fine concentric striæ and a few conspicuous lines of growth towards the base, and sometimes on the middle of the shell, valves nearly equally convex, the beak of the ventral valve being much elevated above, and incurving over the dorsal valve, the ventral valve sometimes marked near the base by a longitudinal depression."

This species is very abundant in the shale of the Niagara group, and somewhat variable in form. It usually has a smooth surface. It is most abundant at Lockport. *Nitida*, Latin, smooth.

Fig. 10, (*Atrypa reticularis*,) LINNE.—This fossil has a very great vertical range, being found in many of the formations from the Clinton upward to the Chemung group. It is nearly circular. The ventral valve is much more convex than the dorsal. The surface is ornamented by from 24 to 30 small rounded plications which bifurcate about one-third of the distance from the beak to the margin, these plications are crossed by concentric elevated lamellæ which give to the surface a reticulated appearance, whence the specific name *reticularis*, net-like, or reticulated. The dorsal valve has often a shallow depression or sinus at the base, and the other a corresponding elevation. The beak of the dorsal valve is small, and but slightly elevated above the ventral valve or hinge line. The cardinal angles are sometimes a little extended beyond the width of the shell.

Figs. 11 and 12, *Atrypa neglecta,* (Hall,) NIAGARA AND CLINTON GROUPS.—Professor Hall says this shell is "ovoid or subpyrimidal, beaks acute, shell gradually enlarging from the beaks to the base, which, in old shells, is deeply sinuate; dorsal valve more convex than the ventral valve, surface marked by simple sharp plications, which are crossed by fine concentric striæ, and sometimes by a few imbricating lines of growth; ventral valve with a mesial sinus below the middle, and a corresponding fold upon the dorsal valve."

"In the young shells the valves are equal, and there is neither sinus or elevation: but as the shell advances in size, the sinus becomes conspicuous. There are generally three, and sometimes four plications in the sinus, and four or five elevated on the opposite valve. The plications usually appear as if smooth, except near the base where there are some strong imbricating lines of growth. It is a very common species, and sufficiently distinct in all its phases to be readily recognized."

It is found in all the localities of the shale of the Niagara Group, and it also occurs in the Clinton group.

Fig. 13, (*Atrypa cuneata,*) DALMAN.—The principal character of this species is its long triangular shape. The plications are ten or twelve, three or four depressed on the ventral, and elevated on the dorsal valve. The beak of the ventral valve is nearly straight, and perforated at the extremity.—This shell is somewhat variable in shape, and the specimens are usually flattened and distorted. *Cuneata,* Latin, wedge-shaped.

It occurs in the Niagara shale, and also in several countries in Europe in the Silurian rocks.

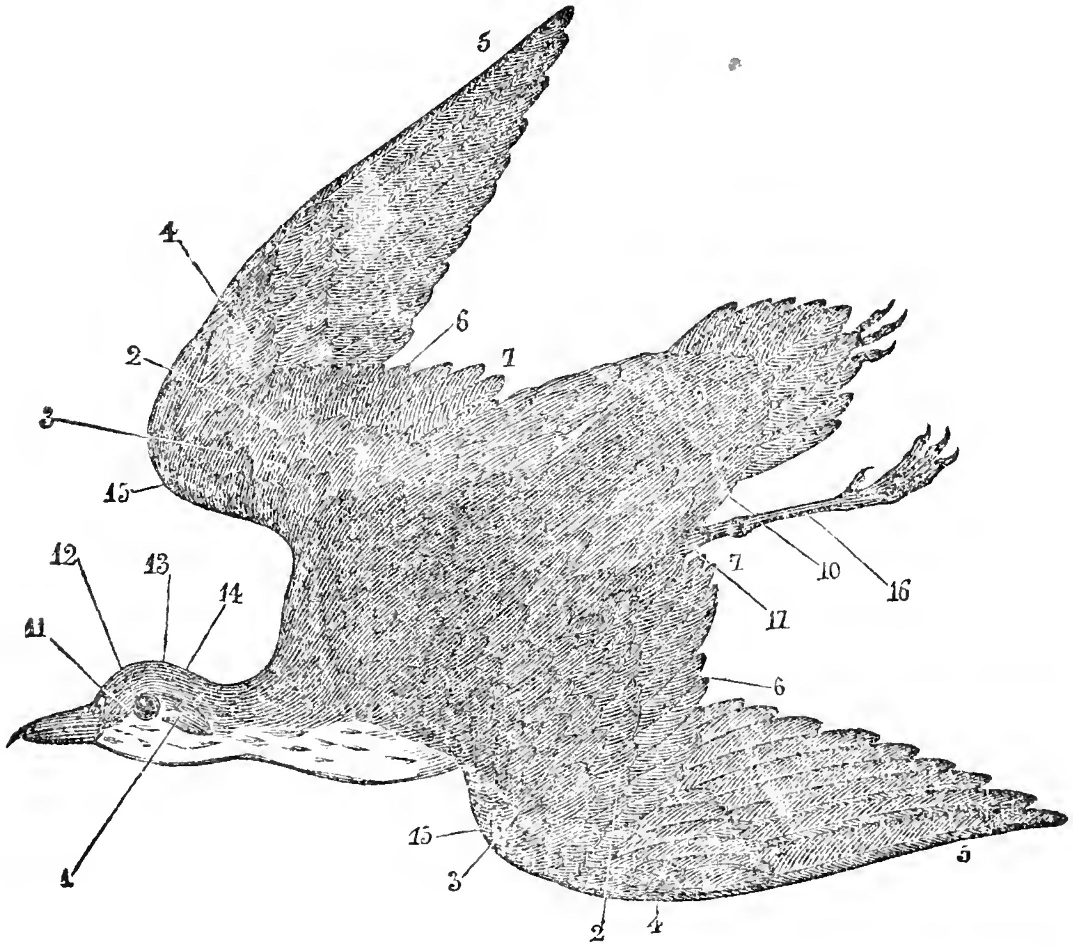
Figs. 14 and 15, *Leptena transversalis,* (Dalman,) NIAGARA GROUP.—This species is semi-circular, and the ventral valve very convex, while the dorsal valve is equally concave. The hinge line is sometimes equal to and often longer than the width of the shell, as in fig. 14. The surface is marked by a number of elevated radiating ridges, the intervals between which are more finely striated. Professor McCoy says of the English specimens, that they are more globose than *Leptena sericia,* and "distinguished externally by the fewer and more distant linear ridges, and the very much finer longitudinal striæ between the thread-like ridges, and their being besides so faintly impressed as to be, in almost all cases, invisible to the naked eye, or a lens of low power. The interior of the dorsal valve shews well the long parallel muscular impressions. Fig. 15 is a view of the hinge line, exhibiting the elevation of the marginal ridges by which these impressions are bounded.—This is one of the most abundant of fossils in the Upper Silurian rocks of America, and we have specimens in our possession from the Trenton Limestone that much resemble it. In Europe it is also quite common.

Figs. 16 and 17, *Leptena subplana,* (Conrad,) NIAGARA GROUP.—This shell is "semi-elleptical, length and width nearly equal, hinge line extending beyond the width of the shell. The surface is marked by prominent sharp striæ, which frequently bifurcate before reaching the margin. The radiating striæ are crossed by strong concentric striæ. The area (Fig. 17,) extends to the extremities of the hinge line, and is narrow, and partially formed by both valves." The valves are almost equally convex, one being usually quite flat, except near the beak, while the other is plano-convex at the beak and slightly convex below. *Subplana,* flattened.

It occurs in the Niagara shale, the most perfect specimens being found adhering to the thin calcarous layers.

The above descriptions, as well as the figures, are principally taken from the second volume of that magnificent work, the Palæontology of New York. In this magazine there is not space to enter into elaborate details. Our plan is to publish at first just so much as may serve to introduce each species to the reader, and afterwards to give further particulars, with notices of Canadian localities. The student must not be discouraged if after several attempts he fails to recognise some of the species, but should rest assured that by further application he will succeed.

ARTICLE XX.—*Ornithology; Technical terms.*



The remarks made concerning the collection and examination of fossils in our previous articles will apply also to birds. There are a few technical terms to be acquired, and these will require only a few minutes study. The best method of proceeding is to procure a specimen of some common species, such as the Robin, and examine the plumage, book in hand. The advantage of understanding the technical terms consists in this, that this knowledge will enable the student to ascertain the name of rare species from the short descriptions given in such works as Audubon's Synopsis of the Birds of America, without purchasing the expensive books in which alone they are well figured. In this Journal it cannot be expected that figures of many birds can be given, and for the common species it is not necessary, as no drawing can equal the originals, which can be procured at any time.

The diagramatic figure given above is taken from Lewis' American Sportsman, and so are the following explanations of the technical terms :—

1. *Auriculars, the ear coverts.*—The soft feathers that cover the organs of hearing.

2, 2. *The bastard wing*, consisting of three or five feathers, resembling the quills of the true wing ; they are placed on a small bone rising from the wrist-joint of the wing. The *bastard wing* assists in flight by keeping the wing from turning upwards, and contracts the points of the wing in a downward and backward position to that of the course of the Bird through the air.

3, 3. *The lesser coverts of the wings.*—These are the feathers which are found in successive rows upon the wings ; those on the inside are termed *under coverts*, and are much less regarded by Ornithologists as a means of distinction than the others.

4, 4. *The greater coverts.*—The wing feathers lying under the *lesser coverts ;* they are much larger and stronger than the latter.

5, 5. *The primaries.*—Large quill feathers taking their growth from below the wrist-joint. The length and proportion of the feathers control, in a wide degree, the movements of the Bird in the air. The nearer the longer *primary quill* approaches the body, the more dexterous and beautiful will be the motion of the Bird when on the wing. The *Hawks, Swallows,* and various other Birds of rapid flight, that seize their prey when on the wing, have the longest *primary* feather very near the body, and consequently are enabled to turn and twist themselves with great facility.

6, 6. *The secondaries*, or *second quill feathers*, spring from the second bone of the wing. When the wing is extended, they frequently appear like a continuation of the *primaries.*

7, 7. *The tertiary*, or *third quill feathers*, also arise from the second bone, but much nearer the elbow-joint.

8, 8. *The scapulars*, or *shoulder feathers*, are formed by the soft and downy feathers that cover the shoulder-bones, and are serviceable only as a protection to the parts which they surround ; they unite without any regularity with the plumage of the back and wings.

9. *The rump feathers and upper-tail coverts.*—These feathers are the continuation of the covering of the back, and are strong in proportion to the peculiar habits of the Bird. In the Woodpecker tribe, for instance, these feathers are very strong and unusually long, as they make constant use of the tail as a support and assistance when climbing the trunks of trees ; and so it is with some water-fowl not web-footed, but obliged frequented to take flight from the water. The *tail feathers* in these last-mentioned Birds afford the greatest assistance in springing into the air.

10. *The vent feathers and under-tail coverts,* that extend from the anus or vent to the tail underneath. These feathers are much longer in some tribes of Birds than others. Those that have a constant habit of flirting by their tails—like, for example, the Rallus Carolinus, and several species of small shore Birds—have the vent feathers unusually well developed.

The *tail feathers* are various in size and numbers, and are generally the most ornamental part of a Bird. The tail performs the most necessary office in the navigation of the Bird through the air; in fact, it is the rudder by which the course of the Bird is determined, and acts in concert with the will of the Bird as freely as a ship obeys her helm.

11. *Loral space.*—The *space* between the bill and eye.
12. *Frons.*—The forehead.
13. *Corona.*—Crown of the head.
14. *Occiput.*—The hind part of the head.
15. *Flexure.*—Bend of the wing.
16. *Tarsi.*—Shanks of legs.
17. *Tibia.*—Thigh.

The *upper* and *lower bills* are called the *superior* and *inferior maxilla,* or upper and lower *mandibles.*

Iris—irides.—The colored circle surrounding the pupil of the eye.

Mentum.—The chin.

Guttur.—The throat.

Collum.—The neck.

Pectus.—The breast.

In measurement, the *total length* means from point of the bill to the end of middle tail feathers. *Length of the wings* means from the *bend* of the wing to the end of the longest quill feather."

The *mirror, speculum* or *Beauty spot,* is a space on the wings of some species with brighter colours than the other parts of the wing.

The length of the wing is generally measured from the tip of one wing to the tip of the other, and the two dimension are simply expressed in figures thus, 24½, 38½; the first indicating the length from the bill to the tail, and the latter the length of the expanded wings.

The above are nearly all the technical terms used in describing birds, and after a few attempts at their application to specimens, they will become fixed in the memory, and give no further trouble. There are many systems of classification proposed by various authors, and to reconcile them all with each other would be impossible; in fact most of them are considered by the best naturalists to be defective, and need not be studied until after some knowledge of the species, and genera has been acquired.

Linnæus, in his *Systema Naturæ,* divides the class of Birds into *six* orders. Blumenbach makes *nine* orders. Cuvier makes *six.* M. Vieillot, a celebrated French Ornithologist, *five.* Mr. N. A. Vigors, *five.* M. C. J. Temminck, in his *Manuel d'Ornithologie, sixteen;* and Professors Agassiz & Gould, in the system published in the second article of this Journal, only *four* orders.

A writer in the *Toronto Globe* of the 11th instant, condemns the system of Professors Agassiz & Gould, and expresses the greatest alarm lest the publication of it in Canada might be injurious to the cause of Natural History.

We have however so much confidence in the great name of AGASSIZ, that we feel justified in stating that the study of no one of his works will retard the student, and that we believe our anonymous reviewer in the *Globe* stands much in need of a small book, such as the "Outlines of Comparative Physiology and Anatomy," from which the system in question was taken. The five orders of Vigors are the following:—

1. *Raptores.*—Birds of Prey.
2. *Insessores.*—Perching Birds.
3. *Rasores.*—Scraping Birds.
4. *Grallatores.*—Wading Birds.
5. *Natatores.*—Swimming Birds.

In the system of Agassiz & Gould, the Insessores appear to include (1.) Birds of Prey, (2.) The Perching Birds of other authors, and (3.) The Scraping Birds; while their order of Scansores or Climbing Birds is considered by Vigors as a tribe only of the Insessores.

In this Journal only species and genera will be described for the present. The student should procure specimens and study them, and acquire as soon as possible an extensive knowledge of species. He should also make observations upon the food, periods of migration, construction of nests, habits, instincts, &c., and commit the same to writing.

In the next article we shall give an account of the common Robin, with the technical description, by way of note, from *Audubon's* Synopsis of the Birds of America.

ARTICLE XXI.—*On the Robin, or Migratory Thrush, (Turdus migratorious.)*

GENUS TURDUS, (Linn.)

GENERIC CHARACTERS.—Bill of moderate length, rather stout, straight, compressed towards the end, and acute; upper mandible slightly notched near the tip; nostrils ovoid, partly concealed by the feathers; tarsus longer than the middle toe, wings of moderate length, first quill very small, the third and fourth longest, tail rather long, nearly even.

TURDUS MIGRATORIOUS, (Linn.)

SPECIFIC CHARACTERS.—*Dark greyish, beneath reddish, head and tail black, the latter with the two exterior feathers white at the tip; male,* 10.14; *female,* 9.13. *Inhabits the United States and British Provinces, to the Arctic regions.*

The Robin, the most common species of the family of Thrushes, is a fine lively bird to be seen everywhere in this country throughout the spring, summer and autumn. It arrives in Canada from the South in the beginning of April, and while numbers of them remain with us, others extend their migration to the far-north, where, as well as in Canada and the United States, they breed. It received its common name from the first European emigrants, from a fanciful resemblance to the *Robin Red-breast* of the British Isles. This latter bird, however, is a member of a different genus, and in systematic works on Ornithology, is called *Erythaca rubecula*, or *Sylvia rubecula*. Our bird is not, properly speaking, a Robin, but a Thrush.—They spend the winter season in the southern countries of North America, but in summer, seem to spread over the whole continent. When we consider that two or three pairs may be seen in an hour's walk anywhere in the country, and that they are equally numerous all over the vast regions where they breed, some idea may be formed of their numbers in the Southern States in the winter, when the whole race is gathered together in a small space.—In Canada the largest flocks are to be seen late in the autumn, when the northern birds are passing through on their way to the South. In the Hudson's Bay Territories, Sir John Richardson says:—"The male is one of the loudest and most assidious of the songsters that frequent the fur countries, beginning his chant immediately on his arrival. Within the arctic circle, the woods are silent in the bright light of noon-day; but towards midnight when the sun travels near the horizon, and the shades of the forest are lengthened, the concert commences, and continues till six or seven in the morning." Its song consists of a number of loud warbling notes, delivered a few at each breath. Its call while feeding or hopping along the ground or fences, consists of several ejaculations, *pwee-sht, pwee-sht, pemp-pemp*, uttered frequently, and with much spirit.

The following is Wilson's account of the bird as observed in the United States:—

"The name of this bird bespeaks him a bird of passage, as are all the different species of Thrushes we have; but the one we are now describing, being more unsettled, and continually roving about from one region to another, during fall and winter, seems particularly entitled to the appellation.—Scarce a winter passes but innumerable thousands of them are seen in the lower part of the whole Atlantic states, from New Hampshire to Carolina, particularly in the neighbourhood of our towns; and, from the circumstance of their leaving, during that season, the country to the north-west of the great range of the Alleghany, from Maryland northward, it would appear that they not only migrate from north to south, but from west to east, to avoid the deep snows that generally prevail on these high regions, for at least four months in the year.

"The Robin builds a large nest, often on an apple-tree, plasters it in the inside with mud, and lines it with hay or fine grass. The female lays five eggs, of a beautiful sea-green. Their principal food is berries, worms, and caterpillars. Of the first he prefers those of the sour gum, (*Nyssa sylvatica*.) So fond are they of gum-berries, that, wherever there is one of these trees covered with fruit, and flocks of Robins in the neighborhood, the sportsman need only take his stand near it, load, take aim, and fire; one flock succeeding another, with little interruption, almost the whole day: by this method, prodigious slaughter has been made among them with little fatigue. When berries fail, they disperse themselves over the fields, and along the fences, in search of worms and other insects. Sometimes they will disappear for a week or two, and return again in greater numbers than before; at which time the cities pour out their sportsmen by scores, and the markets are plentifully supplied with them at a cheap rate. In January, 1807, two young men, in one excursion after them, shot thirty dozen. In the midst of such devastation, which continued many weeks, and, by accounts, extended from Massachusetts to Maryland, some humane person took advantage of a circumstance common to these birds in winter, to stop the general slaughter. The fruit called poke-berries (*Phytolacca decandra*, Linn.) is a favorite repast with the Robin, after they are mellowed by the frost. The juice of the berries is of a beautiful crimson, and they are eaten in such quantities by these birds, that their whole stomachs are strongly tinged with the same red color. A paragraph appeared in the public papers, intimating, that, from the great quantities of these berries which the Robins had fed on, they had become unwholesome, and even dangerous food; and that several persons had suffered by eating of them. The strange appearance of the bowels of the birds seemed to corroberate this account. The demand for, and use of them, ceased almost instantly; and motives of self-preservation produced at once what all the pleadings of humanity could not effect. When fat, they are in considerable esteem for the table, and probably not inferior to the *Turdi* of the ancients, which they bestowed so much pains on in feeding and fattening. The young birds are frequently and easily raised, bear the confinement of the cage, feed on bread, fruits, &c., sing well, readily learn to imitate parts of tunes, and are very pleasant and cheerful domestics. In these I have always observed that the orange on the breast is of a much deeper tint, often a dark mahogany or chesnut color, owing, no doubt, to their food and confinement.

"The Robin is one of our earliest songsters; even in March, while snow yet dapples the fields, and flocks of them are dispersed about, some few will mount a post or stake of the fence, and make short and frequent attempts at their song. Early in April, they are only to be seen in pairs, and deliver their notes with great earnestness, from the top of some tree detached from the woods. This song has some resemblance to, and indeed is no bad imitation of, the notes of the Thrush or Thrasher, (*Turdus rufus;*) but, if deficient in point of execution, he possesses more simplicity, and makes up in zeal what he wants in talent; so that the notes of the Robin, in spring, are universally known, and as universally beloved. They are as it were, the prelude to the grand general concert that is about to burst upon us from woods, fields, and thickets, whitened with blossoms, and breathing fragrance. By the usual association of ideas, we, therefore, listen with more pleasure to this cheerful bird, than to many others possessed of far superior powers, and much greater variety. Even his nest is held more sacred among schoolboys than that of some others; and, while they will exult in plundering a Jay's or a Cat Bird's, a general sentiment of respect prevails on the discovery of a Robin's. Whether he owes not some little of this veneration to the well-known and long-established character of his namesake in Britain, by a like association of ideas, I will not pretend to determine. He possesses a good deal of his suavity of manners; and almost always seeks shelter for his young in summer, and subsistence for himself in the extremes of winter, near the habitations of man.

"The Robin inhabits the whole of North America, from Hudson's Bay to Nootka Sound, and as far south as Georgia, though they rarely breed on this side of the mountains farther south than Virginia. Mr. Forster says, that about the beginning of May they make their appearance in pairs at the settlements of Hudson's Bay, at Severn River; and adds a circumstance altogether unworthy of belief, viz., that, at Moose Fort, they build, lay, and hatch, in fourteen days! but that at the former place, four degrees more north, they are said to take twenty-six days. They are also common in Newfoundland, quitting these northern parts in October. The young, during the first season, are spotted with white on the breast, and in that time have a good deal of resemblance to the Fieldfare of Europe.

"Mr. Hearne informs us, that the red-breasted Thrushes are commonly called, at Hudson's Bay, the Red-Bird—by some, the Blackbirds, on account of their note—and by others, the American Fieldfares; that they make their appearance at Churchill River about the middle of May, and migrate to the south early in the fall. They are seldom seen there but in pairs; and are never killed for their flesh, except by the Indian boys.

"Several authors have asserted, that the red-breasted Thrush cannot brook the confinement of the cage, and never sings in that state. But, except the Mocking Bird, (*Turdus polyglottus,*) I know of no native bird which is so frequently domesticated, agrees better with confinement, or sings in that state more agreeably than the Robin. They generally suffer severely in moulting time, yet often live to a considerable age. A lady, who resides near Tarrytown, on the banks of the Hudson, informed me, that she raised and kept one of these birds for seventeen years; which sang as well, and looked as sprightly, at that age as ever; but was at last unfortunately destroyed by a cat. The morning is their favorite time for song. In passing through the streets of our large cities, on Sunday, in the months of April and May, a little after daybreak, the general silence which usually prevails without at that hour, will enable you to distinguish every house where one of these songsters resides, as he makes it then ring with his music."

The Robin belongs to the family Turdinæ or Thrushes, of which there are three genera and a goodly number of species known in North America. In the classification of Agassiz & Gould, this family belongs to the order *Insessores*. The generic name is from *Turdus*, Latin, a Thrush. The specific name *migratorius*, (incorrectly printed *migratorious* at the commencement of this article,) is derived from the Latin verb *migro*, to remove from one place to another.

The subjoined description of the Robin is taken from Audubon's Synopsis of the Birds of America, page 89 :—

Turdus migratorius, LINN. Migratory Thrush.—Robin.

Male with the bill yellow, the upper part and sides of the head black ; upper parts dark grey with an olivaceous tinge ; quills blackish-brown, margined with light grey ; tail brownish-black, the outer two feathers tipped with white ; three white spots about the eye, throat white, densely streaked with black ; lower part of fore neck, breast, sides, axillars, and lower wing-coverts reddish-orange ; abdomen white ; lower tail-coverts dusky, tipped with white. Female with the tints paler. Young with the fore neck, breast, and sides, pale-reddish, spotted with dusky, the upper parts darker than in the adult. Bill at first dusky, ultimately pure yellow.

Male, 10, 14. *Female*, 9, 13.

From Texas eastward and northward, to the Fur Countries. Throughout the interior. Winters in abundance in all the Southern States. Columbia River. Abundant.

Robin, Turdus migratorius, WILS. Amer. Orn. v. i. p. 35.

Turdus migratorius, BONAP. Syn. p. 75.

Merula migratoria, Red-breasted Thrush, SWAINS. & RICH. F. Bor. Amer. v. ii. p. 176.

American Robin or Migratory Thrush, Turdus migratorius, NUTT. Man. v. i. p. 338.

American Robin or Migratory Thrush, Turdus migratorius, AUD. Orn. Biog. v. ii. p. 190 ; v. v. p. 442.

Merula migratoria, DEKAY, Nat. Hist., New York.

ARTICLE XXII.—*On Black Duck, (Anas obscura.)*

GENUS ANAS, (Linn.)

GENERIC CHARACTERS.—The bill depressed or flattened towards the end ; the upper mandible with a small ovate beak ; the nostrils elliptical and situated near the ridge of the bill, behind the centre of its length ; feet short, stout, placed a little behind the centre of the body ; hind toe very small, third toe longest, fourth a little shorter, but longer than the second ; tail short, much rounded, of 14 to 19 feathers. The name of the genus is Latin, *Anas*, a Duck.

ANAS OBSCURA, (Black or Dusky Duck.)

SPECIFIC CHARACTERS.—*Male, blackish-brown; female, lighter brown ; male,* 24½, 38½ ; *female,* 22, 34½. *Inhabits North America, from Texas to Hudson's Bay Territories.*

The following particulars concerning this fine bird were obligingly prepared for us from his own observation by Mr. Wm. P. LETT, of Ottawa, an ardent and skilful sportsman, and who, in the amount of his knowledge of the water-fowl that visit this portion of Canada, has few, if any equals. Mr. LETT says :—

"The Black Duck is one of the largest species of the duck tribe which visits Canada. It generally makes its appearance here about the 5th of April, and remains throughout the summer until the latter end of October, when it leaves for the South. Few, however, are to be met with in the breeding season, which extends from the 20th of May till the 15th of August. The young are then able to fly, and are much easier to approach than at any other season.

"This species feeds near the shores of streams, and may be found generally in small creeks, lakes, and inland ponds. Its food principally consists of seeds, insects, and small aquatic plants, and it is also fond of grain of different kinds. Large flocks often resort in spring, when the banks of the small rivers are overflown, to stubble fields, particularly where oats have been sown, and solitary pairs are very frequently met with in small pools in fields and meadows adjacent to rivers.

"The Black Duck, seldom, or never dives when feeding; but when wounded, if, for instance, only a wing is broken, it is one of the most cunning and expert divers to be found. In this case, if one is shot when flying and happens to fall into the water, unless the sportsman is experienced in the business, and has a second barrel ready to discharge immediately, there are ten chances to one that he does not get another sight of his game after the first dive. Under such circumstances, they will rise to the surface of the water, exposing only the head as far as the eyes, and the instant they have taken breath, or fancy themselves seen, the head is again drawn under water. In this manner they will dive a distance of ninety or one hundred yards.

"The Black Duck, however, when wounded, invariably resorts to the shore, and travels on land sometimes nearly an acre from the waters. If the sportsman can boast the possession of a well trained dog with a keen nose, his chance is still good. The instant such a dog strikes the trail of the wounded bird, he will follow it up with unerring certainty, and capture the game.

"This fine species of duck is exceedingly wary and difficult to approach, except on ground where the shore cover is thick. The least noise, the breaking of a dry twig, for instance, puts them on the alert, and the appearance of man, even at a distance of three hundred yards, will cause them to take wing. The only time at which they can be approached easily, is at the dawn of the morning when they first make their appearance at their feeding grounds. Except at this early hour, when alarmed, they will rise to a great height in the air and fly a long distance before they again alight; and it is invariably more difficult to approach them after being once alarmed, than at first.

"The flesh of this species, if not superior, is at least equal to that of any other known. It is fully equal to that of the tame duck, to which latter it bears a very full and marked resemblance in form and size. Its uniformity of plumage, however, will give it a claim to distinctiveness as a species, although it may be a question whether it has not a strong claim to be a part of the parent stock of the domestic duck as well as the wild mallard.

"The black duck breeds here on the banks of remote streams and small creeks and lakes. The female lays from twelve to fourteen eggs, and may often be seen with a dozen young ones following her early in the month of July. Of these, probably about six or eight, frequently a fewer number, arrive at maturity, owing to their exposure to the attacks of the "Mink," the "Weasel," and other small predatory animals, from the ravages of which, together with the fox, large numbers of the young broods are destroyed before they are able to fly.

"The flesh of the young birds, at the season, when they are called "*Flappers,*" is very tender and delicious, and it is a matter of regret that very many of them are then killed for the table."

The following are Wilson's remarks on this species:—"This species is generally known along the sea-coast of New Jersey, and the neighbouring country, by the name of the Black Duck, being the most common and most numerous of all those of its tribe that frequent the salt marshes. It is only partially migratory. Numbers of them remain during the summer, and breed in sequestered places in the marsh, or on the sea-islands of the beach. The eggs are eight or ten in number, very nearly resembling those of the Domestic Duck. Vast numbers, however, regularly migrate farther north on the approach of spring. During their residence here in winter, they frequent the marshes, and the various creeks and inlets with which those extensive flats are intersected. Their principle food consists of those minute snail shells so abundant in the marshes. They occasionally visit the sandy beach in search of small bivalves, and, on these occasions, sometimes cover whole acres with their numbers. They roost at night in the shallow ponds, in the middle of the salt marsh, particularly on islands, where many are caught by the foxes. They are extremely shy during the day; and, on the most distant report of a musket, rise from every quarter of the marsh in prodigious numbers, dispersing in every direction. In calm weather they fly high, beyond the reach of shot; but when the wind blows hard, and the gunner conceals himself among the salt grass, in a place over which they usually fly, they are shot down in great numbers; their flight being then low. Geese, Brant, and Black Duck, are the common game of all our gunners along this part of the coast during the winter; but there are at least ten Black Ducks for one Goose or Brant, and probably many more. Their voice resembles that of the Duck and Mallard; but their flesh is greatly inferior, owing to the nature of their food. They are, however, large, heavy-bodied Ducks, and generally esteemed.

"I cannot discover that this species is found in any of the remote northern parts of our continent; and this is probably the cause why it is altogether unknown in Europe. It is abundant from Florida to New England; but is not enumerated among the birds of Hudson's Bay, or Greenland. Its chief residence is on the sea-coast, though it also makes extensive excursions up the tide waters of our rivers. Like the Mallard, they rarely dive for food, but swim and fly with great velocity."

The specific name is derived from the Latin (*obscurus,*) blackish or dark coloured.

The following is the technical description given by AUDUBON:—

Anas obscura, GMEL. Dusky Duck.

Tail much rounded, of eighteen acute feathers, none of which are recurved; bill yellowish-green; feet orange-red, the webs dusky; upper part of head glossy brownish black, the feathers margined with light brown; sides of head and a band over the eye light greyish-brown, with longitudinal dusky streaks; general colour blackish-brown, a little paler beneath, all the feathers margined with pale reddish-brown; wing-coverts greyish-dusky, with a faint tinge of green; ends of secondary coverts velvet black; primaries and their coverts blackish-brown; secondaries

darker; speculum green, blue violet, or amethyst-purple, bounded by velvet-black, the feathers also tipped with a narrow line of white; under surface of wing and axillaries white. Female more brown, with the speculum similar, but without the white terminal line.

Male, $24\frac{1}{2}$, $38\frac{1}{2}$. *Female*, 22, $34\frac{1}{4}$.

Breeds in Texas, westward, and throughout the United States, British Provinces, and Labrador. Columbia River. Common in autumn and spring along the Middle Atlantic Districts. Abundant in the Southern and Western States, in winter.

Dusky Duck, Anas obscura, Wils. Amer. Orn. v. viii. p. 141.
Anas obscura, Bonap. Syn. p. 384.
Dusky Duck, Anas obscura, Nutt. Man. v. ii. p. 392.
Dusky Duck, Anas obscurà, Aud. Orn. Biog. v. iv. p. 15.

ARTICLE XXIII.—*On the Wood Duck, (Anas sponsa.)*

Anas Sponsa, The Wood Duck, or Summer Duck.

Specific Characters.—*The most striking distinctive characters of the male of this species are: the upper part of the head and long pendulous crest deep bronze green, with white stripes; the throat pure white; breast reddish purple, spangled with small triangular white spots; belly white; back brownish black, a white crescent before the wings on either side; the white of the neck curving up towards the eye. Female, head dusky and very slightly crested; throat white; breast and abdomen white; back dark brown. Male, 20½-28; Female, 19½. Breeds throughout United States and British Provinces, to the Hudson's Bay Territories.*

The Wood Duck is remarkable among the swimming birds from the circumstance of its leading a partly arboreal life, perching upon trees, and thus approaching in habit the numerous feathered tribes classed in the order Insessores. There are only a few ducks known that have this habit, and it is said the greater proportion of them are confined to India. The subject of the present article is the only perching duck known to inhabit Canada. All the birds of this group of the Natatores have exceedingly beautiful and splendid plumage, and are particularly distinguished by a long pendulous crest of feathers arising from the posterior portion of the head and running down the back of the neck. Mr. Lett informs us "that our species makes its appearance here about the 5th of April, and remains until the latter end of October. It breeds in this country, building its nest in a hollow tree, to which the same bird will return year after year.

"This bird derives its name from the latter circumstance, as well as from its habit of perching on the branches of trees. This peculiarity is noticeable at the breeding season more than at any other time. Wood ducks are very seldom seen on trees in the fall of the year.

"The male bird of this species is the most beautiful of the whole tribe of Ducks. In a preserved state it is generally to be found among the ornamental curiosities of museums. The female possesses none of the elegant plumage of the male, being simply of a dark brown color on the back and wings, with the breast white. She has, however, the tongue all to herself, possessing the loudest voice of any duck known in Canada.

"Wood Ducks in their habits are very similar to the Black Ducks.— They feed close to the shore, in shallow water, and may often be seen on land in search of food, which consists of nuts, seeds, and small plants.

"They are not so wary or difficult to approach as the Black Duck or the Golden Eye, although they are constantly on the look out for danger.

"This species, in common with every other non-diving species, is very fond of wild rice. Large flocks resort to the rice field to be found at different places on the Ottawa river, when they are shot on the wing as they arrive by sportsmen stationed in a canoe or on a Muskrat-house. The first flocks commonly make their appearance at the rice between sundown and dusk. and flock after flock continue to arrive until midnight. On a clear moonlight night, good sport may be had shooting them as they fly in. Having fed throughout the night, the great body of the birds leave the rice field before daylight to fly to their usual places of resort for many miles around, those remaining about the place during the day which have been hatched in the vicinity.

"Although the wood duck never dives when feeding, it is a cunning and active diver when wounded. It is a fact well known to sportsmen acquainted with the habits of ducks that frequently, when mortally wounded, this duck will dive and seize with its bill a weed growing at the bottom of the river, to which it may be found in shallow water, firmly attached after death.

"The female Wood Duck, shortly after hatching her young, conveys them from the height where her nest is built to the ground, by seizing them in her bill. The young, as do the young of every other species, when pursued or alarmed, will dive and immediately conceal themselves in hiding places, where they remain till the danger is over, which they are made aware of by the voice of the parent bird calling them together again.

"In the moulting season the male bird loses his fine variegated tuft, but he may still be distinguished from the female by the colors of his bill and the well marked outlines of the brilliant hues peculiar to his head."

The following are some of Wilson's remarks :—"It is familiarly known in every quarter of the United States, from Florida to Lake Ontario, in the neighborhood of which latter place I have myself met with it in October.— It rarely visits the sea-shore, or salt marshes, its favorite haunts being the solitary, deep, and muddy creeks, ponds and mill-dams of the interior, making its nest frequently in old, hollow trees that overhang the water.

"The Summer Duck is equally well known in Mexico and many of the West India Islands. During the whole of our winters, they are occasionally seen in the States south of the Potomac. On the 10th of January, I met with two on a creek near Petersburgh, in Virginia. In the more northern districts, however, they are migratory. In Pennsylvania, the female usually begins to lay late in April or early in May. Instances have been known where the nest was constructed of a few sticks laid in a fork of the branches;

usually, however the inside of a hollow tree is selected for this purpose. On the 18th of May I visited a tree containing the nest of a Summer Duck, on the banks of Tuckahoe River, New Jersey. It was an old, grotesque white oak, whose top had been torn off by a storm. It stood on the declivity of the bank, about twenty yards from the water. In this hollow and broken top, and about six feet down, on the soft, decayed wood, lay thirteen eggs, snugly covered with down, doubtless taken from the breast of the bird.—These eggs were of an exact oval shape, less than those of a Hen, the surface exceedingly fine grained, and of the highest polish, and slightly yellowish, greatly resembling old, polished ivory. The egg measured two inches and an eight by one inch and a half. On breaking one of them, the young bird was found to be nearly hatched, but dead, as neither of the parents had been observed about the tree during the three or four days preceding, and were conjectured to have been shot.

"This tree had been occupied, probably by the same pair, for four successive years, in breeding time; the person who gave me the information, and whose house was within twenty or thirty yards of the tree, said that he had seen the female, the spring preceding, carry down thirteen young, one by one, in less than ten minutes. She caught them in her bill by the wing or back of the neck, and landed them safely at the foot of the tree, whence she afterwards led them to the water. Under this same tree, at the time I visited it, a large sloop lay on the stocks, nearly finished; the deck was not more that twelve feet distant from the nest, yet notwithstanding the presence and noise of the workmen, the Ducks would not abandon their old breeding place, but continued to pass out and in, as if no person had been near. The male usually perched on an adjoining limb, and kept watch while the female was laying, and also often while she was sitting. A tame Goose had chosen a hollow space at the root of the same tree, to lay and hatch her young in.

"The Summer Duck seldom flies in flocks of more than three or four individuals together, and most commonly in pairs, or singly. The common note of the drake is *peet, peet;* but when, standing sentinel, if he sees danger, he makes a noise not unlike the crowing of a young cock, *oe eek! oe eek!* Their food consists principally of acorns, seeds of wild oats, and insects.—Their flesh is inferior to that of the Blue-winged Teal. They are frequent in the markets of Philadelphia.

"Among other gaudy feathers with which the Indians ornament the calumet or pipe of peace, the skin of the head and neck of the Summer Duck is frequently seen covering the stem.

"This beautiful bird has often been tamed, and soon becomes so familiar as to permit one to stroke its back with the hand. I have seen individuals so tamed, in various parts of the Union. Captain Boyer, collector of the port of Havre-de-Grace, informs me, that about forty years ago, a Mr. Nathan Nichols, who lived on the west side of Gunpowder Creek, had a whole yard swarming with Summer Ducks, which he had tamed and completely domesticated, so that they bred and were as familiar as any other tame fowls; that he (Captain Boyer) himself saw them in that state, but does not know what became of them. Latham says, that they are often kept in European menageries, and will breed there."

The specific name appears to be Latin, (*Sponsa*) a bride. We shall conclude this notice of the Wood Duck with the very full description given in Audubon's Synopsis, page 280 :—

Anas Sponsa, Linn. Wood Duck.—Summer Duck.

Male with the feathers of the head and upper and hind part of neck elongated and incurved, inner secondaries very broad, tail much rounded, of sixteen feathers; bill bright red at the base, yellow on the sides, ridge and unguis black ; feet greenish-yellow ; upper part of head and loral space deep green ; below the eye a patch of dark purple, behind it a larger patch of the same colour ; sides of neck, its hind part under the crest, and the middle all round, very dark purple ; a narrow line along the base of the upper mandible and over the eye, meeting on the occiput, pure white, as are some of the feathers of the crest; another from behind the eye meeting below the occiput, and including several of the lower elongated feathers ; throat pure white, with a process on each side a little beyond the eye, and another nearly half-way down the neck; sides of the neck and its lower part anteriorly reddish-purple, each feather on the latter with a triangular white tip ; middle of the neck behind, back and rump, very dark reddish-brown, the latter deeper, and tinged with green; upper tail-coverts and tail greenish-black ; some of the lateral tail-coverts dull reddish-purple, a few on either side with their central filaments light red ; smaller wing coverts, alula, and primaries dull greyish brown, most of the latter, with part of the outer web greyish-white, and the inner toward the end darker and glossed with green ; secondary quills tipped with white, the outer webs green with purple reflections, those of the inner secondaries and scapulars velvet-black, their inner webs partially glossed and changing to green; the broad feathers anterior to the wings white, terminated with black ; breast and abdomen greyish-white ; feathers under the wings yellowish grey, minutely undulated with black, and tipped with a white and two black bands ; lower wing-coverts and axillar feathers white, barred with greyish-brown ; lower tail-coverts dull greyish-brown. Female with the bill blackish-brown, the feet dull green ; upper part of head dusky glossed with green, sides of head and neck, with hind part of latter, light brownish-grey; throat white, but without the lateral processes; fore part of neck below and sides light yellowish-brown, mottled with dark greyish-brown, as are the sides under the wings ; breast and abdomen white, the former spotted with brown; hind neck, back, and rump dark brown, glossed with green and purple ; wings as in the male, but the speculum less, and the secondaries externally faint reddish-purple, the velvet-black of the male diminished to a few narrow markings; tail dark brown, glossed with green ; lower tail-coverts pale greyish-brown, mottled with white.

Male, $20\frac{1}{2}$, 28. *Female*, $19\frac{1}{2}$.

Breeds throughout the country from Texas to the Columbia, and eastward to Nova Scotia. Fur Countries. Accumulates in the Southern Districts in winter.

Summer Duck or Wood Duck, Anas sponsa, Swains. & Rich. F. Bor. Amer. v. viii. p. 97.

Dendronessa sponsa, Summer Duck, Swains & Rich. F. Bor. Amer. v. ii., p. 446.

Summer or Wood Duck, Anas sponsa, Nutt. Man. v. ii. p. 394.

Wood Duck, Anas sponsa, Aud. Orn. Biog. v. iii. p. 52 ; v. v. p. 618.

ARTICLE XXIV.—*On the Green-winged Teal, (Anas Carolinensis.)*

ANAS CAROLINENSIS, (Step) AMERICAN GREEN-WINGED TEAL.

SPECIFIC CHARACTERS.—*Male, head and upper part of neck chesnut red; a broad green band from the eye down the back of the neck; upper part and flank crossed by crowded blackish, brown and white undulating lines; mirror green, margined above and below with black, and before and behind with white; bill black; feet light bluish grey; the head has a short crest. Female, greyish, mottled with dark brown. Male,* 14¾ 24; *Female,* 13¾ 22½. *Inhabits United States and British Territories—Canada in Spring and Autumn; Winter in Southern States.*

Wilson was of opinion that the American Green-winged Teal should be considered identical with the European species. We believe, however, that most Naturalists are now satisfied with the opposite view, and that our bird is sufficiently well marked to be classified as distinct from that of the eastern continent. The male in full plumage is a very neat and even beautiful bird, while the female is clothed with more sober and matronly colours. They make their appearance in Canada in the month of April and the beginning of May, being then on their route to the northern territories, where they remain during the summer to rear their young. In the autumn they again return, their numbers being greatly increased. They are not often seen in the summer in Canada. They frequent the ponds, marshes, inundated lands, and reedy shores of creeks and rivers. They fly about and feed during the night, associating often with other species of Ducks. Mr. LETT says:—"Their flight is exceedingly rapid and irregular, and their mode of alighting sudden and abrupt. They are also very easily approached, and do not exhibit so much alarm at the proximity of man as many of the larger species. Their note is a short hoarse *quack*, which, however, is seldom heard, except when they are suddenly alarmed and put to flight. It is very doubtful whether they breed in this part of Canada or not; it is certain, however, that young broods of this species are never seen here. The Green-winged Teal resorts chiefly to inundated land in the spring, and to shallows near the shores, and adjacent to rapids in the autumn. They do not dive when feeding, but when wounded are almost equal to the Golden Eye or Loon at diving."

Wilson's description of the Green-winged Teal is as follows:—

"The Green-winged Teal is fifteen inches in length, and twenty-four inches in extent; bill, black; irides, pale brown; lower eyelid, whitish; head, glossy reddish chestnut; from the eye backwards to the nape runs a broad band of rich silky green, edged above and below by a fine line of brownish white; the plumage of the nape ends in a kind of pendent crest; chin, blackish; below the chestnut, the neck, for three quarters of an inch, is white, beautifully crossed with circular, undulating lines of black; back, scapulars, and sides of the breast, white, thickly crossed in the same manner; breast elegantly marked with roundish or heart-shaped spots of black, on a pale vinaceous ground, variegated with lighter tints; belly, white; sides, waved with undulating lines; lower part of the vent-feathers, black; sides of the same, brownish white, or pale reddish cream; lesser wing-coverts, brown ash; greater, tipped with reddish cream; the first five secondaries, deep velvety black, the next five resplendent green, forming the speculum or beauty spot, which is bounded above by pale buff, below by white, and on each side by deep black; primaries, ashy brown; tail, pointed, eighteen feathers, dark drab; legs and feet, flesh colored. In some, a few circular touches of white appear on the breast near the shoulder of the wing. The windpipe has a small, bony labyrinth where it separates into the lungs; the intestines measure three feet six inches, and are very small and tender.

"The female wants the chestnut bay on the head, and band of rich green through the eye, these parts being dusky white, speckled with black; the breast is grey brown, thickly sprinkled with blackish, or dark brown; the back, dark brown, waved with broad lines of brownish white; wing, nearly the same as in the male.

"This species is said to breed at Hudson's Bay, and to have from five to seven young at a time. In France, it remains throughout the year, and builds in April, among the rushes on the edges of the ponds. It has been lately discovered to breed, also, in England, in the mosses about Carlisle.—It is not known to breed in any part of the United States. The Teal is found in the north of Europe as far as Iceland, and also inhabits the Caspian Sea to the south; extends likewise to China, having been recognised by Latham among some fine drawings of the birds of that country."

The latter remarks of Wilson are founded upon his supposition that our species and the European Teal (*Anas crecca*) are the same species.

ARTICLE XXV.—*On the Blue-winged Teal, (Anas discors.)*

ANAS DISCORS, (Linn) BLUE-WINGED TEAL.

SPECIFIC CHARACTERS.—*Male, head blackish, glossed with green and purple, a crescent of white in front of the eye; back brownish black, with semi-oval spots of brownish white; sides and belly greyish brown, barred and spotted with dusky; some of the wing coverts blue; general appearance greyish; speculum green; bill bluish black; feet dull yellow. Female, head dusky slate, and without the purple and violet of the male. Male, 16-31¼; Female, 15-24. Inhabits United States and British Territories. Breeds in the north.*

The blue-winged teal is seldom seen here until late in the season, and then only in limited numbers. It is nearly as large as the wood-duck, although much shorter in the body and neck. They are generally seen in flocks of perhaps from eight to twelve, feeding in low marshy ground upon the shores of rivers. Their flight is very rapid, like that of a pigeon, and when about to alight they drop down suddenly, like a snipe or wood-cock. The flesh of this species is excellent, and may be considered quite a delicacy for the table, compared with many others of the duck species.

Ths bird, like the black duck, never dives in feeding, but when wounded, like the latter, dives with great rapidity and cunning.

The blue-winged Teal is comparatively easy to approach, consequently it falls an easy sacrifice to the gun of the sportsman. The male and female bird differ but little in plumage, both being of a light grey color and marked with a blue spot on the wing. In shape this species is precisely similar to the black duck, and in habit much the same, both delighting to feed around the muddy shores of rivers. This species does not breed in this part of Canada. They generally make their first appearance here about the month of July, and they are then in excellent condition.

The above are Mr. Lett's observations on this bird, and the following is the description given by Wilson, in his American Ornithology:—

"The blue-winged Teal is the first of its tribe that returns to us in the autumn from its breeding place in the north. They are usually seen early in September, along the shores of the Delaware, where they sit on the mud close to the edge of the water, so crowded together that the gunners often kill great numbers at a single discharge. When a flock is discovered thus sitting and sunning themselves, the experienced gunner runs his batteau ashore at some distance below or above them, and getting out, pushes her before him over the slippery mud, concealing himself all the while behind her; by this method he can sometimes approach within twenty yards of the flock, among which he generally makes great slaughter. They fly rapidly, and, when they alight, drop down suddenly, like the Snipe or Woodcock, among the reeds or on the mud. They feed chiefly on vegetable food, and are eagerly fond of the seeds of the reeds or wild oats. Their flesh is excellent, and, after their residence for a short time among the reeds, become very fat. As the first frosts comes on, they proceed to the south, being a delicate bird, very susceptible of cold. They abound in the inundated rice-fields, in the Southern States, where vast numbers are taken in traps placed on small, dry eminences, that here and there rise above the water. These places are strewed with rice, and by the common contrivance called a *figure four*, they are caught alive in hollow traps. In the month of April they pass through Pennsylvania for the north, but make little stay at that season. I have observed them numerous on the Hudson opposite to the Katskill Mountains. They rarely visit the sea-shore.

"This species measures about fourteen inches in length, and twenty-two inches in extent; the bill is long in proportion, and of a dark dusky slate; the front and upper part of the head are black; from the eye to the chin is a large crescent of white; the rest of the head and half the neck are of a dark slate, richly glossed with green and violet; remainder of the neck and breast is black or dusky, thickly marked with semicircles of brownish white, elegantly intersected with each other; belly, pale brown, barred with dusky, in narrow lines; sides and vent, the same tint, spotted with oval marks of dusky; flanks elegantly waved with large semicircles of pale brown; sides of the vent, pure white; under tail-coverts, black; back, deep brownish black, each feather waved with large semi-ovals of brownish white; lesser wing coverts, a bright light blue; primaries, dusky brown; secondaries, black; speculum, or beauty spot, rich green; tertials edged with black or light blue, and streaked down their middle with white; the tail, which is pointed, extends two inches beyond the wings; legs and feet, yellow, the latter very small; the two crescents of white, before the eyes, meet on the throat.

"The female differs in having the head and neck of a dull dusky slate, instead of the rich violet of the male; the hind head is also whitish; the wavings on the back and lower parts, more indistinct; wing, nearly the same in both."

The specific name is Latin, (*Discors,*) harsh or jarring, probably in allusion to the hoarse quack of this species.

ARTICLE XXVI.—*On the Mallard, (Anas boschas.)*

Anas Boschas, (Linn,) The Mallard.

Specific Characters.—*Male, head and neck deep green, a white ring round the neck; breast, brownish chestnut; back, brownish black; belly and sides, pale grey, crossed by fine undulating lines of darker colour; speculum, purple and green; bill, greenish yellow; feet, orange red; rump, black, green, and purplish blue; some of the tail feathers curled; general appearance, similar to that of the tame drake. Female, yellowish, spotted with dusky brown; male, 24, 36; female, 22. Inhabits and breeds throughout North America.*

This fine bird so much resembles certain varieties of the common domesticated species, that the sportsman, when seen in possession of them, generally brings himself under the suspicion of having committed a depredation upon some neighbouring farm yard. In the part of Canada where we are writing, in the valley of the Ottawa, they are not so common as many other species. They are only rarely seen in our immediate vicinity. Sir John Richardson says they abound in the Hudson's Bay Territories, breeding in the woody district up to their most northern limits, in lat. 68°. It is there migratory across the continent, common on the Sascatchewan in summer, but spends the winter in the South. Wilson thus describes the species :—

"The Mallard, or Common Wild-Drake, is so universally known as scarcely to require a description. It measures twenty-four inches in length, by three feet in extent, and weighs upwards of two pounds and a half; the the bill is greenish yellow; irides hazel; head, and part of neck, deep glossy changeable green, ending in a narrow collar of white; the rest of the neck and breast are of a dark purplish chestnut; lesser wing-coverts, brown ash; greater, crossed near the extremities with a band of white, and tipped with another of deep velvety black; below this lies the speculum, or beauty spot, of a rich a splendid light purple, with green and violet reflections, bounded on every side with black; quills, pale brownish ash; back, brown, skirted with paler; scapulars, whitish, crossed with fine, undulating lines of black; rump and tail-coverts, black, glossed with green; tertials, very broad, and pointed at the ends; tail, consisting of eighteen feathers, whitish, centred with brown ash, the four middle ones excepted, which are narrow, black, glossed with violet, remarkably concave, and curled upwards to a complete circle; belly and sides, a fine gray, crossed by an infinite number of fine, waving lines, stronger and more deeply marked as they approach the vent; legs and feet, orange red.

"The female has the plumage of the upper parts dark brown, broadly bordered with brownish yellow; and the lower parts yellow ochre, spotted and streaked with deep brown; the chin and throat, for about two inches, plain yellowish white; wings, bill, and legs, nearly as in the male.

"The windpipe of the male has a bony labyrinth, or bladder-like knob, puffing out from the left side. The intestines measures six feet, and are as wide as those of the Canvass-Back. The windpipe is of uniform diameter, until it enters the labyrinth.

"This is the original stock of the common domesticated Duck, reclaimed, time immemorial, from a state of nature, and now become so serviceable to man. In many individuals, the general garb of the tame drake seems to have undergone little or no alteration; but the stamp of slavery is strongly imprinted in his dull, indifferent eye and grovelling gait, while the lofty look, long, tapering neck, and uprightly action of the former bespeak his native spirit and independence.

"The Common Wild Duck is found in every fresh-water lake and river of the United States in winter, but seldom frequents the sea-shores or salt marshes. Their summer residence is the north, the great nursery of this numerous genus. Instances have been known of some solitary pairs breeding here in autumn. In England these instances are more common. The nest is usually placed in the most solitary recess of the marsh, or bog, amidst coarse grass, reeds, and rushes, and generally contains from twelve to sixteen eggs, of a dull greenish white. The young are led about by the mother in the same manner as those of the Tame Duck, but with a superior caution, a cunning and watchful vigilance peculiar to her situation. The male attaches himself to one female, as among other birds in their native state, and is the guardian and protector of her and her feeble brood. The Mallard is numerous in the rice-fields of the Southern States during winter, many of the fields being covered with a few inches of water; and, the scattered grains of the former harvest lying in abundance, the Ducks swim about, and feed at pleasure.

"The flesh of the Common Wild Duck is in general and high estimation; and the ingenuity of man, in every country where it frequents, has been employed in inventing stratagems to overreach these wary birds, and procure a delicacy for the table. To enumerate all these various contrivances would far exceed our limits; a few, however, of the most simple and effective may be mentioned.

"In some ponds frequented by these birds, five or six wooden figures, cut and painted so as to represent Ducks, and sunk, by pieces of lead nailed on their bottoms, so as to float at the usual depth on the surface, are anchored in a favorable position for being raked from a concealment of brush, &c., on shore. The appearance of these usually attracts passing flocks, which alight, and are shot down. Sometimes eight or ten of these painted wooden Ducks are fixed on a frame in various swimming postures, and secured to the bow of the gunner's skiff, projecting before it in such a manner that the weight of the frame sinks the figures to their proper depth; the skiff is then dressed with sedge or coarse grass in an artful manner, as low as the water's edge; and under cover of this, which appears like a party of Ducks, swimming by a small island, the gunner floats down sometimes to the very skirts of a whole congregated multitude, and pours in a destructive and repeated fire of shot among them. In winter, when detached pieces of ice are occasionally floating in the river, some of the gunners on the Delaware paint their whole skift or canoe white, and, laying themselves flat at the bottom, with their hand over the side, silently managing a small paddle, direct it imperceptibly into or near a flock, before the Ducks have distinguished it from a floating mass of ice, and generally do great execution among them. A whole flock has sometimes been thus surprised asleep with their heads under their wings. On land another stratagem is sometimes practised with great success. A large, tight hogshead is sunk in the flat marsh, or mud, near the place where Ducks are accustomed to feed at low water, and where otherwise there is no shelter; the edges and top are artfully concealed with tufts of long, coarse grass, and reeds or serge. From within this the gunner, unseen and unsuspected, watches his collecting prey, and, when a sufficient number offers, sweeps them down with great effect. The mode of catching Wild Ducks, as practised in India, China, the Island of Ceylon, and some parts of South America, has been often described, and seems, if reliance may be placed on those accounts, only practicable in water of a certain depth. The sportsman, covering his head with a hollow wooden vessel, or calabash, pierced with holes to see through, wades into the water, keeping his head only above, and, thus disguised, moves in among the flock, which take the appearance to be a mere floating calabash, while, suddenly pulling them under by the legs, he fastens them to his girdle, and thus takes as many as he can conveniently stow away, without in the least alarming the rest. They are also taken with snares made of horse hair, or with hooks baited with small pieces of sheep's lights, which, floating on the surface, are swallowed by the Ducks, and with them the hooks. They are also approached under cover of a stalking horse, or a figure formed of thin boards, or other proper materials, and painted so as represent a horse or ox."

In England this is one of the species captured in thousands, in the fens, by means of decoys. It is spread all over Europe and North America, and it is said to exist even in India, and like most of the prolific and widely extended species, subject to great variations of form and plumage in domestication.

The specific name is Greek, (*Boschas,*) a wild duck.

ARTICLE XXVII.—*On a Sea-Gull shot at Ottawa.*

LARUS ARGENTATUS, (Brunnich,) HERRING OR SILVERY GULL.

On the 15th of April inst., Mr. W. H. Baldwin, of the ALBION HOTEL, shot a fine gull near this city, which appears to us to be the common species described by Ornithologists under the name of LARUS ARGENTATUS, the Herring or Silvery Gull. The bird had one of the wings broken by the shot, but it appears to be otherwise uninjured. Mr. Baldwin has amputated the broken wing, and his patient seems to feel very little inconvenience by the loss. It is a very beautiful bird, with pure snow-white plumage, except the upper part of the wings and back, which are greyish blue. It is exceedingly tame, suffering itself to be handled and caressed without exhibiting any alarm, and feeding upon the small fish and bread provided for it with as much nonchalance as if it were feasting in freedom on its native waters. It will eat almost anything given to it, but prefers the small fresh fish. It exhibits no disposition to escape, and is not confined otherwise than being shut up in an out-house, where it runs about at will, and when turned out in the yard endeavours to return to the building. These facts seem to prove that this gull can be easily domesticated after the first terror arising from the contact with man has been passed through.

The Gulls are web-footed, but their legs are longer than those of the Ducks, and nearer the centre of the body, so that these birds are good walkers, approaching in this respect the appearance of waders. Some of this family, such as the Petrels, "seem even to employ their feet in their own element as if on land, walking as it were upon the surface of the waters." They are also characterised by the strength and expansiveness of their wings, with the aid of which they traverse immeasurable tracts of the ocean in search of food, and support their flight at great distances from the land, seldom having recourse to their powers of swimming. They are a numerous tribe, and spread over the whole world of waters in every clime. They are omniverous, many are of large size, and all are voracious devourers of fish, and of every marine animal, whether dead or alive, which is cast upon the shore. The Herring or Silvery Gull is common about our great lakes and rivers, most numerous in the spring and autumn, but although apparently always upon the wing and flying about for hours in the same place, does not usually approach within gun shot, and specimens are therefore not often procured. We give below the technical description of the species from Audubon's Synopsis. Mr. Baldwin's specimen differs somewhat, and still we think it the same.—

Instead of silvery white, the iris is yellowish white; the feet are greyish flesh colour; the patch of white on the first primary is only an inch in length on each web, and there is no circular patch on the inner web of the second; but, as Audubon says, "the terminal markings vary," perhaps these differences are of little importance.

The technical names of this species are Latin, *Larus*, a gull; *argentatus*, silvery.

Audubon thus describes the species:—

Bill robust, compressed, gamboge-yellow, with an orange-red patch toward the end of the lower mandible; iris silvery-white; feet flesh-coloured; head, neck, lower parts, rump, and tail, pure white; back and wings, light greyish blue; edges of wing and extremities of quills, white; the first six quills brownish black towards the end, that colour including the outer webs and the greater part of the inner of the first two, and on the rest gradually diminishing, so as on the sixth merely to form a bar; the first quill with a patch of white about an inch and a half long on both webs near the end, the second with a circular patch on the inner web; the tips of all white. The terminal markings of the outer quills vary. Young with the bill brownish black, paler at the base of the lower mandible, feet purplish flesh colour; general colour of plumage, light purplish grey, the upper part of the head darker, the lower parts mottled with pale yellowish grey; feathers of upper parts and upper-tail coverts, irregularly edged and barred with greyish white; primary quills greyish black, terminally margined with whitish; tail of the same colour, its base and the outer webs of the lateral feathers irregularly mottled with whitish, the tips brownish white.

Male, 23, 53. *Young*, in winter, 18¾, 51.

Abundant in autumn, winter, and early spring, from Texas along the whole Atlantic coast of Newfoundland. Breeds from the Bay of Fundy to Melville Island. Common in autumn on the Great Lakes, the Ohio, and Mississippi.

Larus argentatus, Bonap. Syn. p. 360.
Herring Gull, Larus argentatus, Nutt. Man. v. ii. p. 304.
Herring Gull, Larus argentatus, Aud. Orn. Biog. v. iii. p. 588; v. v. p. 638.

The Canadian Institute, Geological Survey, &c.—The Journal of the Canadian Institute is now conducted by an able editorial corps, composed principally of the Professors of the University and Colleges at Toronto, while it is, at the same time, open to communications from the numerous members of the Society, upon any of the sciences to which its pages are devoted. The March number contains many articles, reviews, scientific and literary notes, all of them of great value.

The Canadian Institute is doing a vast deal of good in calling into activity throughout the country, energies which we have no hesitation in stating would have long slumbered but for that Institution. The same may be said of the Geological Survey. The development of the resources of Canada, the working out of its physical structure, and the exploration of its mineral treasures are not its only services. It has excited curiosity and a desire to acquire information which must lead to important educational results. Reputation abroad,—good name to nations is of as much value as it is to individuals. To be known as a country where the arts and sciences are vigorously cultivated, is to have a good repute. In the department of which we are now speaking, there is much remaining to be done, both by labour and science, and it will be productive of the greatest injury to Canada not to carry out the Survey to its completion.

Errata.—On page 134, 30th line from the top, for "Frias," read "Trias." On page 142, for "*migratorious*," read "*migratorius*."

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ARTICLE XXVIII.—*On the Natural History of the Salmon, (Salmo salar,) with remarks upon its economical importance and preservation;* By FRANK FORELLE. Written for the Canadian Naturalist and Geologist.

SAINT CATHERINES, C.W., June, 1856.

The Salmon is a fresh-water fish. It passes the whole of the first year of its life and two-thirds of every other in the fresh water, making annual and sometimes bi-annual migrations to the sea. It may be that we do not yet fully know why they make these visits to the sea, but their chief object seems to be food of different quality and perhaps greater quantity than can be found in fresh water. This opinion is based upon the fact that after its first year the Salmon never increases in size while in fresh water; but, on the contrary, diminishes gradually every day, both in muscle and fat, after coming from the ocean.

There is no fish that in beauty or flavor can compare with a Salmon when fresh from the sea, for then he is in the highest condition, and may be well esteemed by both sportsman and epicure as the king of fishes. At this time, the color along the back is a blueish black, with green reflections, which diminishes in intensity as it approaches the lateral line; below this, it is a clear silvery white. The head is somewhat darker than the back. The dorsal, pectoral, and caudal fins are a dusky black, the ventrals are light-colored, and the anals are silvery white, like the belly. There are usually a few dark spots on the gill covers, which extend along the lateral line through the entire length of the body. These are most conspicuous in the females. The fins are then soft and the sides and belly covered with sea-lice.

As spawning time approaches and the fish seek the swift, shallow waters at the head of the streams, considerable changes take place in their appearance. The male assumes the appearance known in England as "Red" fish. The sides take on an orange hue, paling into yellow on the belly, the spots become of a bloody-red, and are seen on the dorsal and caudal fins; the back becomes greenish, and the cheek is striped with orange. The lower jaw also elongates into a hooked cartilaginous excrescence, which fits into the upper. The females grow darker, particularly upon the back, fins, and gill-covers, and are now called "Black" fish.

After spawning they are lank and lean, with heads much larger in proportion to their bodies. The females change to a greyish color on the back and yellow on the sides, with red and dusky spots alternating above the lateral line, and extended upon the dorsal and caudal fins, while the pectoral, ventral, and anal fins become of a blueish grey. They are now called Kelts.

In the classification given on the thirtieth page of this magazine, the Salmon belongs to the order called Cycloids; in the system heretofore in use, it falls under the order of soft-rayed abdominal fishes; family Salmonidæ, genus Salmo: specific name, *Salmo salar.*

The body is covered with thin oval scales, but the head is smooth or free from scales. There are two dorsal fins, the first with thirteen rays, the second fatty, long and rounded, and without any rays. The pectoral fins have twelve rays, and the ventral nine, the anal fin nine, and the caudal nineteen. The head is one-fifth of the whole length of the fish, the eyes are small, and the nostrils are placed much nearer to the eyes than to the point of the nose. The lateral line is straight, and runs very nearly through the centre. In adults, the caudal fin is lunated, but in the young fish it is considerably forked. The branchiostegous rays, or bony rays of the gill-covers, are usually from ten to twelve, but are not always the same on both sides. It has strong sharp teeth on all the maxillary and both palatine bones; there are one or two teeth, rarely more than two, and frequently but one, on the vomer, and three to five on the tongue.

Such are some of the leading features by which this beautiful fish may be distinguished, beautiful indeed, whether it swims in its native element, its sides sparkling like molten silver, or smoking on the table it graces the beginning of the feast.

As soon as the rivers are free from ice, say from the middle of May to the first of June, the Salmon, grown fat and silvery on their sea-found food, appear in the Estuaries, where they usually remain for a time, going up with the flood and returning with the Ebb. In those rivers of Great Britain which run clear as early as February, they have been observed to make a second migration to the sea before running up to spawn. I am not informed whether this has been observed in any of the Salmon rivers of the Provinces, but am disposed to believe that in as much as the season is so far advanced before our rivers are free from ice, they seldom, if ever, make a second migration to the sea in the same year.

It seems that they remain for a time in the brackish waters as a preparatory step to their approaching inland journey. When they first come from the sea, as has been observed, they are fat and heavy, their sides are covered with sea-lice, and their fins are soft from the action of the salt water. By remaining a short time in the fresher water of the Estuaries, they rid themselves of the sea-lice, gradually lose something in weight and fatness, and their fins becoming hardened, are more capable of sustaining them in their often long and laborious ascent, while the fish themselves become proportionably more active and muscular.

About the end of July they begin to ascend the rivers, seeking the spot where they were born and where they passed the first year of their life.—With a strength and velocity almost incredible, they stem the most powerful current and shoot up the swiftest rapids; nor do cascades always present insuperable obstacles; up these they frequently leap with astonishing vigor, and though they fail in their first attempts by no means are they discouraged, but resting awhile at the foot to recruit their strength, they try again and again, until the feat is accomplished, and they reach the top of their mountain stream.

The height to which Salmon can leap is stated variously. Scrope (Days and Nights of Salmon Fishing.) says that six feet in height is more than the average leap of the Salmon, while very large fish, he thinks, could in deep water leap much higher. Ephemera, in Bell's Life in London, Jan. 4, 1854, seems to doubt whether the Salmon can leap *much* higher than six feet. Moses H. Perley, whose accurate observations have thrown much light upon the Natural History of our Fishes, say they frequently leap falls ten and twelve feet in height, and that "it is believed the utmost limit of perpendicular height which a Salmon can attain in leaping is fourteen feet." Wm. H. Herbert, in his very interesting work on the Fish and Fishing of America, says, "I once watched a Salmon for above an hour endeavouring to pass a mill dam on the river Wharfe, a Salmon river in the West Riding of Yorkshire. The dam was of great height, 13 or 14 feet at least, and was formed with a sort of step midway, on which the water fell, making a double cascade. While I was watching him, this fish, which was, I suppose, of some seven or eight pounds, made above twenty leaps, constantly alighting from his spring about midway the upper shoot of the water, and being constantly swept back into the eddy at its foot. After a pause of about a couple of minutes, he would try it again, and such were his vigor and endurance, that he at last succeeded in surmounting the formidable obstacle."

The old fable, that in making these leaps the Salmon take their tails in their mouths and rise by the force of the spring, like an Elastic bow, has been long exploded, and I was much surprised to find a writer in Putnam's Monthly for March, 1855, gravely repeat the silly tale. Scrope says "they rise very rapidly from the very bottom to the surface of the water by means of rowing and sculling, as it were, with their fins and tail; and this powerful impetus bears them upwards in the air, on the same principle that a few tugs of the oar make a boat shoot outwards after one has ceased to row."—Ephemera says, "the ascending motion is caused by the Salmon striking the water downwards with its pectoral, ventral, and dorsal fins, aided by bodily muscular action." There is no doubt this muscular exertion often gives to the fish, its curvilinear form.

The Salmon do not breed in lakes, nor ponds, nor any deep or still water. It is only in the shallows, where the waters run clean and swift over gravelly and sandy bottoms, that they deposit their eggs. It is for this that they seek the heads of the streams, shooting up the rapids and leaping the water falls, counting no exertion nor fatigue too great, if they may but safely deposit the hopes of future years where the highly ærated waters rippling over their procreant cradle, may quicken the embryo Salmon into life.

In the ascent, the females lead the way. After reaching the river sources, when the water has cooled to about 42° Farenheit, they prepare to deposit their spawn. By this time the male and female have put on respectively the appearance known as "Red" fish and "Black" fish. The female seek out their mates, and pairing off, they choose a spawning place, from which, if possible, they drive away all other fish. Ephemera, describing the manner in which they deposit their eggs, says, "a Salmon spawning-bed is constructed thus;—The fish having paired, chosen their spot for bed-making, and being ready to lie-in, they drop down a stream a little, and then rushing back with velocity towards the spot selected, they dart their heads into the gravel, burrowing with their snouts into it. This burrowing action, assisted with the powers of the fins, is performed with great force, and the water's current aiding, the upper part or roof of the excavation is removed. The burrowing process is continued, until a first nest is dug sufficiently capacious for a first deposition of ova. Then the female enters this first hollowed link of the bed and deposits therein a portion of her ova. That done, she retires down stream and the male instantly takes her place, and pouring, by emission, a certain quantity of milt over the deposited ova, impregnates them. After this, the fish commences a second excavation immediately above the first, and in a straight line with it. In making the excavations they relieve one another. When one fish grows tired of its work it drops down stream until it is refreshed, and then with renovated powers resumes its labors, relieving at the same time its partner. The partner acts in the same spirit, and so their labor progresses by alternate exertion. The second bed completed, the female enters it as she did the first, again depositing a portion of ova, and drops a little down stream. The male forthwith enters the excavation, and impregnates the ova in it. The different nests are not made on the same day, but on different days, progressively. The ova in the first nest are covered with gravel and sand dug from the second, being carried into it chiefly by the action of the current. The excavating process just described is day by day continued until the female has no more ova to deposit. The last deposition of ova is covered in by the action of the fish and water, breaking down some of the gravel crust above and over the nest. Thus is formed a complete spawning bed, not at once, not by a single effort, but piecemeal, and at several intervals of greater or less duration, according to the age and size of the fish and quantity of ova to be deposited." They are usually occupied from five to ten days.

When this task is accomplished they descend the stream to the nearest pool and there remain awhile to recruit. They are now Kelts, and unfit to be eaten. After they have somewhat recovered from the exhausting process of spawning, they proceed slowly down stream to the tide waters, where they linger a time before going out to their ocean feeding grounds. In Great Britain it has been observed that these streams which empty into a sea having a north and south direction, the Salmon, on returning, swim northward. It was long a matter of inquiry what they fed upon at sea. Upon opening their stomachs, Sir Humphrey Davy found only a little yellow fluid, and the parastical worms which bred there. That they found food of some kind, and that in great abundance, was well proved by their coming back in a few months so much increased in flesh and flavor. The microscopical observations of Dr. Knox have shewn that their sea food consists of the eggs of Echinodermata and Crustacea.

Let us now go back and look after the Salmon eggs which we left buried up in the sand and gravel at the bottom of the stream. Careful observations and experiments recently made in Great Britain, have disclosed many important particulars relating to the hatching and growth of the young Salmon. It has been ascertained that the time between the deposition of the ova and the appearance of the little fish varies with the temperature of the water. When the water is at 36° Farenheit, they are hatched in 114 days, when at 43° in 101 days, and when at 45° in 90 days. When the fish are first hatched the yolk of the egg is found adhering to the under side of the little fry; this is gradually absorbed, but does not wholly disappear until the expiration of about four weeks. During this time the fry are entirely supported or fed by this yolk, and feeling no hunger they make no effort to procure food. When first hatched they are about five-eighths of an inch long, of a pale peach blossom color, and by the time they are two months old, they have grown to about an inch and a quarter in length. During this period their growth is very slow, at six months they are not more than three inches and a half long, and are easily recognized by the transverse dusky bars which mark their sides, and the small red dots about the lateral line.—They are now called Parr, * and retain this appearance and name until they have grown to the length of about seven inches. But here a change suddenly comes over them, they loose the dusky transverse markings and red spots, and take on a more Salmon-like appearance; the back and sides down to the lateral line assume a dusky greenish hue, the sides below the lateral line and the belly, and the ventral and anal fins a shining silvery white. The fish is now one year old, and is called a Salmon Smolt. As soon as this change

* The Parr appearance is believed to be common to the young of all the *Salmonidæ* at a certain age.

has taken place the young Salmon seems to hear the far off roar of the ocean and to have dreams of the pleasant feeding grounds away down in its fathomless deeps, for now he starts sea-ward, nor tarries long until he bathes for the first time in its salt waters. Here he remains about three months, feeding, as is now believed, principally on the eggs of the sea-urchin and the crab, which diet, with his sea-bathing, so well agrees with his constitution that though weighing not more than seven ounces when he left the river he will return at the end of three months weighing not less than four or five pounds. At this stage of his growth he is called a Grilse, not yet having attained that maturity which entitled him to the name of Salmon, and is, by an experienced observer, to be distinguished from a small Salmon, mainly by the smaller scales, longer and larger fins and more forked tail. The Grilse are however capable of propagating their kind, and for this purpose ascend the streams in July and August, returning again to the sea when their work is done, where they remain to the following spring, when they appear again in the rivers now having attained their maturity, as full grown Salmon, weighing ten or may be twenty pounds.

Economically, the Salmon is worthy of more than a passing consideration. There is no fish that ranks so high in general estimation, whether he be fresh, pickled, or smoked. For this reason he has been most mercilessly hunted, without regard to condition or age. It is all one whether he be "fair, fat, and forty," fresh from the sea; or lean, lank, and big-headed, just from the spawning beds; whether a full-grown Salmon at the maximum of size and value, or a Grilse not having attained more than half his growth, nay, even a Smolt or a Parr. In the United States they have long since left the waters of the Hudson and the Connecticut, and are yearly diminishing in the Kennebeck and Penobscot; and there is much reason to fear the same result in our own waters. Nor is it to the thoughtless destruction only of the fish that we are to attribute their rapid decrease. The erection of dams on the streams of such height that few or none can ascend to the spawning grounds, necessarily compels the Salmon to forsake them. It is a question well worthy the consideration of every political economist, of every one who has an interest in the full development of the resources of his country, (and who has not?) whether these abundant waters may not, without prejudice to their fullest use for navigation and manufactures, continue, in their fisheries, to be sources of wealth to the province. An examination of the exports of Canada will shew that in 1852 the value of the fish exported was £70,961; in 1853, £82,753; and in 1854, £84,730. The Beef and Pork taken together exported in 1854 amounted to only £33,544 14s. 6d., not worth half as much as the fish. I have not the means of ascertaining how large a portion of the fish were Salmon, but this I do know, that as the Salmon is the most valuable, fish for fish, the more we can develope our resources in Salmon, the more proportionably shall we add to the value of our fisheries. That with proper regulations, these resources can be more fully developed, is abundantly proved by the vast increase of Salmon in the Tay, Forth, Clyde, and other rivers, since the enforcement of protective laws.

In the Foyle the produce has been raised from forty-three tons to very nearly three hundred tons per annum. The movement of steamers and other vessels in no degree interferes with their migrations, nor do the din and clang of saw-mills, with light glaring the night through, frighten them from their journeyings. Nor need their movements be impeded by perpendicular dams of such height as to prevent them from running freely up and down the rivers. All difficulty is at once obviated by constructing an apron or slope on the lower side of every dam, extending from the top of the dam to the bottom of the river below, with a smooth even surface, sloping at an angle of forty-five degrees with the horizon, and located in the main channel of the stream. By enforcing the maintenance of such aprons to every dam, and restricting the capture of the fish to those seasons when alone they are fit for food and to that size which may be supposed to denote their maturity, a vast amount of wealth might be secured to Canada from the Salmon fishery. I have seen it stated, but have not the means of verifying it, that in the Provinces of Nova Scotia and New Brunswick the exports of Salmon alone, apart from the home consumption, which is enormous, amounts "to the annual value of several hundred thousands of pounds sterling." And with such noble rivers as we possess, what is to hinder us from deriving a like advantage? The Salmon demand of us no care for themselves, nor toil in raising and preparing food on which to fatten them; old ocean gives them free pasturage, and all they ask at our hands is the opportunity to propagate and grow.

Auxilliary to protective legislation is the diffusion among all classes of correct information respecting their Natural History and their economical value. The owner of a mill site needs to understand it is but just that, in erecting his dom, he should be obliged to build it in such a manner as not to make it a tax on the whole province by diminishing one of its sources of wealth. The fisherman should know that he can not be allowed to impoverish the fishery by taking half grown fish, merely that his immediate gains may be a little greater. And the dweller on the inland streams should learn to distinguish the spawning from the fresh run fish, and to know that the little Fry, the Smolt, and the Grilse, if suffered to remain in their native element, will in a few more months become the noble Salmon; and that the laws which forbid their capture are really made for his benefit.

Nothing has been said of the Salmon as a fish of game, how he has lured Sir Humphrey Davy from his Philosophy, Chitty from his Law, Wilson from his University; nor is there any need to one who has felt his arrowy rush and listened to the music of the swift running reel. A word might well be said illustrative of his habits under trying circumstances; how when the barbed iron is in his jaw, he leaps and runs and struggles to be free; how he tries to throw himself upon the lightened line, or to smash the tackle against a rock, but there is neither time nor space.

In Canada, the Salmon are found in the St. Lawrence and its tributaries, especially its large northern tributaries, and northward of the Gulf, in every stream that runs to the ocean. Some five and twenty years ago they were abundant in Lake Ontario, running up the streams that emptied into it from the North, but the causes already enumerated have compelled them to seek more accessible spawning grounds. A few still return to their old haunts along the northern shore, but ere long some Canadian Cooper may write of "the last of the Salmon." The same is true of the streams from the South, save that in the Salmon River, in the State of New York, they have been re-established by the enforcement of judicious laws. The Salmon have never been known to enter the Niagara River, though frequently taken at its mouth; as if they knew its bold banks and deep current afforded no spawning bed, and that its cataract no Salmon could hope to leap.

In the streams of New Brunswick and Nova Scotia they still abound, though even there, the same reckless disregard of their habits, according to the testimony of Mr. Perley, points to their extermination at no very distant day.

ARTICLE XXIX.—*On the Pigeon, (Ectopistes Migratoria.)*

V. G. AUDUBON, ESQ., Son of AUDUBON the great Ornithologist, and proprietor of his works, has, with the greatest kindness, given me permission to make extracts for this Magazine, not only from the works of his illustrious father, but also from his own. Several other eminent Naturalists and learned Societies have granted me similar favours, which will be acknowledged in the proper place.

E. B.

GENUS ECTOPISTES, (Linn.)

GENERIC CHARACTERS.—"Bill straight, of ordinary length, rather slender, broader than high at the base, with a tumid fleshy covering, compressed towards the end; head small, oblong; neck of moderate length; body rather slender; feet short; tarsus as short as the hind toe and claw, anteriorly scutellate; outer toe slightly shorter than inner; claws rather short, stout, arched, obtuse; plumage compact above; blended but firm beneath; wings long; first and second quills longest, and about equal; tail long, cuneate, pointed."—(AUDUBON'S SYNOPSIS, page 194.)

The name of this genus appears to have been derived from the Greek, (*Ektopisteos,*) which signifies "frequently changing place or habitation."

ECTOPISTES MIGRATORIA, (Linn.)—The Blue Pigeon, Passenger Pigeon, or Wandering long tailed Dove.

SPECIFIC CHARACTERS.—*Male, upper parts, light greyish blue; throat, fore-neck, and breast, light brownish red; abdomen and lower tail coverts, white. Female, with tints much duller, the upper parts inclining to yellowish brown, the lower parts pale greyish, anteriorly tinged with yellowish brown. Male,* 16¼, 25; *Female,* 15, 23. *The specific name is from the Latin, (Migratorius,) Wandering.*

The family of birds to which our common blue Pigeon belongs, consists of a great many species distributed over all the tropical and temperate climates of the world. Several varieties are described as inhabiting North America, but only one, so far as we have ascertained, visits Canada; and it is so generally known in the country, that it appears almost superfluous to give any description of it here. The principal peculiarity of the bird, however,—we mean its amazing gregariousness, is not often witnessed to its full extent in this Province, and we shall therefore give the interesting account furnished by Wilson in full, it is as follows :—

"This remarkable bird merits a distinguished place in the annals of our feathered tribes,—a claim to which I shall endeavor to do justice; and, though it would be impossible, in the bounds allotted to this account, to relate all I have seen and heard of this species, yet no circumstance shall be omitted with which I am acquainted, (however extraordinary some of these may appear,) that may tend to illustrate its history.

"The Wild Pigeon of the United States inhabits a wide and extensive region of North America, on this side of the great Stony Mountains, beyond which, to the westward, I have not heard of their being seen. According to Mr. Hutchins, they abound in the country round Hudson's Bay, where they usually remain as late as December, feeding, when the ground is covered with snow, on the buds of juniper. They spread over the whole of Canada; were seen by Captain Lewis and his party near the Great Falls of the Missouri, upwards of 2,500 miles from its mouth, reckoning the meanderings of the river; were also met with in the interior of Louisiana by Colonel Pike; and extend their range as far south as the Gulf of Mexico; occasionally visiting or breeding in almost every quarter of the United States.

"But the most remarkable characteristic of these birds is their associating together, both in their migrations, and also during the period of incubation, in such prodigious numbers, as almost to surpass belief; and which has no parallel among any other of the feathered tribes on the face of the earth, with which naturalists are acquainted.

NOTE.—The family is called COLUMBINÆ or COLUMBIDÆ, from the Latin, *Columba*, a dove. It contains a number of closely allied genera, the proper arrangement of which appears to have given much trouble to Ornithologists.— Audubon makes three genera in North America, *Columba*, *Starnœnas* & *Ectopistes*, and the species are :—

1. Columba fasciata, Band-tailed Dove.
2. C——— leucocephala, White-headed Dove.
3. C——— Zenaida, Zenaida Dove.
4. C——— montana, Key-west Dove.
5. C——— passerina, Passerine Dove—Ground Dove.
6. Starnænas cyanocephala, Blue-headed Ground Dove.
7. Ectopistes migratoria, Passenger Pigeon.
8. E——— Carolinensis, Carolinia Long-tailed Dove.

These, with the exception of *E. migratoria*, are all confined to the Southern and Western portions of the continent. We understand that several others have been added since the publication of Audubon's works.

In the British Isles there are four indigenous species :—

1st. The Ring Dove, Cushat, or Wood Pigeon, *Columba palumbus*.
2nd. The Rock or Wild Pigeon, *Columba livia*.
3rd. The Smaller Wood Pigeon, *Columba œnas*.
4th. The Turtle Dove, *Columba turtur*.

All the varieties of the domestic Pigeon, both of America and Europe, have the Rock Pigeon, *C. livia*, for their stock.

"These migrations appear to be undertaken rather in quest of food, than merely to avoid the cold of the climate; since we find them lingering in the northern regions, around Hudson's Bay, so late as December; and, since their appearance is so casual and irregular, sometimes not visiting certain districts for several years in any considerable numbers, while at other times they are innumerable. I have witnessed these migrations in the Genesee country, often in Pennsylvania, and also in various parts of Virginia, with amazement; but all that I had then seen some of them were mere straggling parties, when compared with the congregated millions which I have since beheld in our western forests, in the states of Ohio, Kentucky, and the Indiana territory. These fertile and extensive regions abound with the nutritious beech nut, which constitutes the chief food of the Wild Pigeon. In seasons when these nuts are abundant, corresponding multitudes of Pigeons may be confidently expected. It sometimes happens that, having consumed the whole produce of the beech trees, in an extensive district, they discover another, at the distance perhaps of sixty or eighty miles, to which they regularly repair every morning, and return as regularly in the course of the day, or in the evening, to their place of general rendezvous, or, as it is usually called, the roosting place. These roosting places are always in the woods, and sometimes occupy a large extent of forest. When they have frequented one of these places for some time, the appearance it exhibits is surprising.—The ground is covered to the depth of several inches with their dung; all the tender grass and underwood destroyed; the surface strewed with large limbs of trees, broken down by the weight of the birds clustering one above another; and trees themselves, for thousands of acres, killed as completely as if girdled with an axe. The marks of this desolation remain for many years on the spot; and numerous places could be pointed out, where, for several years after, scarcely a single vegetable made its appearance.

"When these roosts are first discovered, the inhabitants, from considerable distances, visit them in the night with guns, clubs, long poles, pots of sulphur, and various other engines of destruction. In a few hours, they fill many sacks, and load their horses with them. By the Indians, a Pigeon roost, or breeding place, is considered an important source of national profit and dependence for that season; and all their active ingenuity is exercised on the occasion. The breeding place differs from the former in its greater extent. In the western countries above mentioned, these are generally in beech woods, and often extend in nearly a straight line across the country for a great way. Not far from Shelbyville, in the state of Kentucky, about five years ago, there was one of these breeding places, which stretched through the woods in nearly a north and south direction; was several miles in breadth, and was said to be upwards of forty miles in extent! In this tract, almost every tree was furnished with nests, wherever the branches could accommodate them. The Pigeons made their first appearance there about the 10th of April, and left it altogether, with their young, before the 25th of May.

"As soon as the young were fully grown, and before they left the nests, numerous parties of the inhabitants, from all parts of the adjacent country, came with wagons, axes, beds, cooking utensils, many of them accompanied by the greater part of their families, and encamped for several days at this immense nursery. Several of them informed me, that the noise in the woods was so great as to terrify their horses, and that it was difficult for one person to hear another speak, without bawling in his ear. The ground was strewed with broken limbs of trees, eggs, and young Squab Pigeons, which had been precipitated from above, and on which herds of hogs were fattening. Hawks, Buzzards, and Eagles, were sailing about in great numbers, and seizing the Squabs from their nests at pleasure; while, from twenty feet upwards to the tops of the trees, the view through the woods presented a perpetual tumult of crowding and fluttering multitudes of Pigeons, their wings roaring like thunder, mingled with the frequent crash of falling timber; for now the axe-men were at work, cutting down those trees that seemed to be most crowded with nests, and contrived to fell them in such a manner, that, in their descent, they might bring down several others; by which means the falling of one large tree sometimes produced two hundred Squabs, little inferior in size to the old ones, and almost one mass of fat. On some single trees, upwards of one hundred nests were found, each containing *one* young only; a circumstance, in the history of this bird, not generally known to naturalists. It was dangerous to walk under these flying and fluttering millions, from the frequent fall of large branches, broken down by the weight of the multitudes above, and which, in their descent, often destroyed numbers of the birds themselves; while the clothes of those engaged in traversing the woods were completely covered with the excrements of the Pigeons.

"These circumstances were related to me by many of the most respectable part of the community in that quarter, and were confirmed in part, by what I myself witnessed. I passed for several miles through this same breeding place, where every tree was spotted with nests, the remains of those above described. In many instances, I counted upwards of ninety nests on a single tree; but the Pigeons had abandoned this place for another, sixty or eighty miles off, towards Green River, where they were said at that time to be equally numerous. From the great numbers that were constantly passing over head to or from that quarter, I had no doubt of the truth of this statement. The mast had been chiefly consumed in Kentucky, and the Pigeons, every morning, a little before sunrise, set out for the Indiana territory, the nearest part of which was about sixty miles distant. Many of these returned before ten o'clock, and the great body generally appeared, on their return, a little after noon.

"I had left the public road to visit the remains of the breeding place near Shelbyville, and was traversing the woods with my gun, on my way to Frankfort, when, about one o'clock, the Pigeons, which I had observed flying the greater part of the morning northerly, began to return, in such immense numbers as I never before had witnessed. Coming to an opening, by the side of a creek called the Benson, where I had a more uninterupted view, I was astonished at their appearance. They were flying, with great steadiness and rapidity, at a height beyond gunshot, in several strata deep, and so close together, that, could shot have reached them, one discharge could not have failed of bringing down several individuals. From right to left, as far as the eye could reach, the breadth of this vast procession extended, seeming every where equally crowded. Curious to determine how long this appearance would continue, I took out my watch to note the time, and sat down to observe them. It was then half-past one. I sat for more than an hour, but instead of a diminution of this prodigious procession, it seemed rather to increase both in numbers and rapidity; and, anxious to reach Frankfort before night, I rose and went on. About four o'clock in the afternoon I crossed the Kentucky River, at the town of Frankfort, at which time the living torrent above my head seemed as numerous and as extensive as ever. Long after this I observed them, in large bodies that continued to pass for six or eight minutes, and these again were followed by other detached bodies, all moving in the same south-east direction, till after six in the evening. The great breadth of front which this mighty multitude preserved would seem to intimate a corresponding breadth of their breeding place, which, by several gentlemen, who had lately passed through part of it, was stated to me at several miles. It was said to be in Green county, and that the young began to fly about the middle of March. On the 17th of April, forty-nine miles beyond Danville, and not far from Green River, I crossed this same breeding place, where the nests for more than three miles, spotted every tree: the leaves not being yet out, I had a fair prospect of them, and was really astonished at their numbers. A few bodies of Pigeons lingered yet in different parts of the woods, the roaring of whose wings was heard in various quarters around me.

"All accounts agree in stating, that each nest contains only one young Squab. These are so extremely fat, that the Indians, and many of the whites, are accustomed to melt down the fat for domestic purposes, as a substitute for butter and lard. At the time they leave the nest, they are nearly as heavy as the old ones; but become much leaner after they are turned out to shift for themselves. *

"It is universally asserted, in the western countries, that the Pigeons, though they have only one young at a time, breed thrice, and sometimes four times, in the season: the circumstances already mentioned render this highly probable. It is also worthy of observation, that this takes place during that period when acorns, beech nuts, &c. are scattered about in the greatest abundance, and mellowed by the frost. But they are not confined to these alone,—buckwheat, hempseed, Indian corn, holly-berries, hack-berries, huckleberries, and many others, furnish them with abundance at almost all seasons. The acorns of the live oak are also eagerly sought after by these birds, and rice has been frequently found in individuals killed many hundred miles to the northward of the nearest rice plantation. The vast quantity of mast which these multitudes consume is a serious loss to the bears, pigs,

* Wilson was mistaken in supposing that the Pigeon rears but one at a time. The eggs are two, and each brood consists generally of a male and female. The female sits 15 days, and the young leave the nest in 8 days after they are hatched. There are three or four broods in a year, between May and September.

squirrels, and other dependents on the fruits of the forest. I have taken, from the crop of a single Wild Pigeon, a good handful of the kernels of beech nuts, intermixed with acorns annd chestnuts. To form a rough estimate of the daily consumption of one of these immense flocks, let us first attempt to calculate the numbers of that above mentioned, as seen in passing between Frankfort and the Indiana territory: If we suppose this column to have been one mile in breadth, (and I believe it to have been much more,) and that it moved at the rate of one mile in a minute, four hours, the time it continued passing, would make its whole length two hundred and forty miles. Again, supposing that each square yard of this moving body comprehended three Pigeons, the square yard in the whole space, multiplied by three, would give two thousand two hundred and thirty millions, two hundred and seventy-two thousand Pigeons!—an almost inconceivable multitude, and yet probably far below the actual amount. Computing each of these to consume half a pint of mast daily, the whole quantity at this rate would equal seventeen millions four hundred and twenty-four thousand bushels per day! Heaven has wisely and graciously given to these birds rapidity of flight and a disposition to range over vast uncultivated tracts of the earth, otherwise they must have perished in the districts where they resided, or devoured up the whole productions of agriculture, as well as those of the forests.

"A few observations on the mode of flight of these birds must not be omitted: the appearance of large detached bodies of them in the air, and the various evolutions they display, are strikingly picturesque and interesting.— In descending the Ohio by myself, in the month of February, I often rested on my oars to contemplete their aerial manœuvres. A column, eight or ten miles in length, would appear from Kentucky, high in air, steering across to Indiana. The leaders of this great body would sometimes gradually vary their course, until it formed a large bend, of more than a mile in diameter, those behind tracing the exact route of their predecessors. This would continue sometimes long after both extremities were beyond the reach of sight; so that the whole, with its glittery undulations, marked a space on the face of the heavens resembling the windings of a vast and majestic river. When this bend became very great, the birds, as if sensible of the unnecessary circuitous course they were taking, suddenly changed their direction, so that what was in column before became an immense front, straightening all its indentures; until it swept the heavens in one vast and infinitely extended line. Other lesser bodies also united with each other as they happened to approach, with such ease and elegance of evolution, forming new figures, and varying these as they united or separated, that I never was tired of contemplating them. Sometimes a Hawk would make a sweep on a particular part of the column, from a great height, when, almost as quick as lightning, that part shot downwards out of the common track; but, soon rising again, continued advancing at the same height as before. This inflection was continued by those behind, who, on arriving at this point, dived down, almost perpendicularly, to a great depth, and rising, followed the exact path of those that went before. As these vast bodies passed over the river near me, the surface of the water, which was before smooth as glass, appeared marked with innumerable dimples, occasioned by the dropping of their dung, resembling the commencement of a shower of large drops of rain or hail.

"Happening to go ashore, one charming afternoon, to purchase some milk at a house that stood near the river, and while talking with the people within doors, I was suddenly struck with astonishment at a loud rushing roar, succeeded by instant darkness, which, on the first moment, I took for a tornado, about to overwhelm the house and every-thing around in destruction. The people, observing my surprise, cooly said, "It is only the Pigeons;" and, on running out, I beheld a flock, thirty or forty yards in width, sweeping along very low, between the house and the mountain, or height, that formed the second bank of the river. These continued passing for more than a quarter of an hour, and at length varied their bearing so as to pass over the mountain, behind which they disappeared before the rear came up.

"In the Atlantic States, though they never appear in such unparalleled multitudes, they are sometimes very numerous; and great havoc is then made amongst them with the gun, and clap net, and various other implements of destruction. As soon as it is ascertained in a town that the Pigeons are flying numerously in the neighborhood, the gunners rise *en masse;* the clap nets are spread out on suitable situations, commonly on an open height in an old buckwheat field; four or five live Pigeons, with their eyelids sewed up, are fastened on a moveable stick—a small hut of branches is fitted up for the fowler, at the distance of forty or fifty yards—by the pulling of a string, the stick on which the Pigeons rest, is alternately elevated and depressed, which produces a fluttering of their wings similar to that of birds just alighting; this being perceived by the passing flocks, they descend with great rapidity, and, finding corn, buckwheat, &c., strewed about, begin to feed, and are instantly, by the pulling of a cord, covered by the net. In this manner, ten, twenty, and even thirty dozen, have been caught at one sweep. Meantime, the air is darkened with large bodies of them, moving in various directions; the woods also swarm with them in search of acorns; and the thundering of musketry is perpetual on all sides, from morning to night.—Wagon loads of them are poured into market, where they sell from fifty to twenty-five, and even twelve cents per dozen; and Pigeons become the order of the day at dinner, breakfast, and supper, until the very name becomes sickening. When they have been kept alive, and fed for some time on corn and buckwheat, their flesh acquires great superiority; but, in their common state, they are dry and blackish, and far inferior to the full grown young ones, or Squabs.

"The nest of the Wild Pigeon is formed of a few dry slender twigs, carelessly put together, and with so little concavity, that the young one, when half grown, can easily be seen from below. The eggs are pure white. Great numbers of Hawks, and sometimes the Bald Eagle himself, hover about those breeding places, and seize the old or the young from the nest, amidst the rising multitudes, and with the most daring effrontery. The young, when beginning to fly, confine themselves to the under part of the tall woods, where there is no brush, and where nuts and acorns are abundant, searching among the leaves for mast, and appear like a prodigious torrent rolling along through the woods, every one striving to be in the front.—Vast numbers of them are shot while in this situation. A person told me, that he once rode furiously into one of these rolling multitudes, and picked up thirteen Pigeons, which had been trampled to death by his horse's feet.—In a few minutes they will beat the whole nuts from a tree with their wings, while all is a scramble, both above and below, for the same. They have the same cooing notes common to domestic Pigeons, but much less of their gesticulations. In some flocks you will find nothing but young ones, which are easily distinguishable by their motley dress. In others, they will be mostly females; and again, great multitudes of males, with few or no females. I cannot account for this in any other way than that, during the time of incubation, the males are exclusively engaged in procuring food, both for themselves and their mates; and the young, being unable yet to undertake these extensive excursions, associate together accordingly. But, even in winter, I know of several species of birds who separate in this manner, particularly the Red-winged Starling, among whom thousands of old males may be found, with few or no young or females along with them.

"Stragglers from these immense armies settle in almost every part of the country, particularly among the beech woods, and in the pine and hemlock woods of the eastern and northern parts of the continent. Mr. Pennant informs us, that they breed near Moose Fort, at Hudson's Bay, in N. lat. 51°, and I myself have seen the remains of a large breeding place as far south as the country of the Choctaws, in lat. 32°. In the former of these places they are said to remain until December; from which circumstance, it is evident that they are not regular in their migrations, like many other species, but rove about, as scarcity of food urges them. Every spring, however, as well as fall, more or less of them are seen in the neighborhood of Philadelphia; but it is only once in several years that they appear in such formidable bodies; and this commonly when the snows are heavy to the north, the winter here more than usually mild, and acorns, &c., abundant.

"The Passenger Pigeon is sixteen inches long, and twenty-four inches in extent; bill, black; nostril, covered by a high rounding protuberance; eye, brilliant fiery orange; orbit or space surrounding it, purplish flesh-colored skin; head, upper part of the neck, and chin, a fine slate blue, lightest on the chin; throat, breast, and sides, as far as the thighs, a reddish hazel; lower part of the neck, and sides of the same, resplendent changeable gold, green, and purplish crimson, the latter most predominant; the ground color, slate; the plumage of this part is of a peculiar structure, ragged at the ends; belly and vent, white; lower part of the breast, fading into a pale vinaceous red; thighs, the same; legs and feet, lake, seamed with white; back, rump, and tail-coverts, dark slate, spotted on the shoulders with a few scattered marks of black; the scapulars tinged with brown; greater coverts, light slate; primaries and secondaries, dull black, the former tipped and edged with brownish white; tail, long, and greatly cuneiform, all the feathers tapering towards the point, the two middle ones plain deep black, the other five, on each side, hoary white, lightest near the tips, deepening into bluish near the bases, where each is crossed on the inner vane with a broad spot of black, and nearer the root with another of ferruginous; primaries, edged with white; bastard wing, black.

"The female is about half an inch shorter, and an inch less in extent; breast, cinereous brown; upper part of the neck, inclining to ash; the spot of changeable gold, green, and carmine, much less, and not so brilliant; tail-coverts, brownish slate; naked orbits, slate colored; in all other respects like the male in color, but less vivid, and more tinged with brown; the eye not so brilliant an orange. In both, the tail has only twelve feathers."

ARTICLE XXX.—*On the Species of Woodpeckers observed in the vicinity of the City of Ottawa.*

Genus Picus, (Linn.)

Generic Characters.—Bill stout, straight, angular, and generally wedge-shaped towards the tip; nostrils elliptical or oblong, situated at the base of the bill, and concealed by bristly feathers; legs, short; toes, three or four; claws large, strong, much curved, compressed very acute; wings of moderate length, or long, with the first quill very small, the third, fourth, and fifth longest; tail of twelve feathers, the lateral very small, and the three middle pairs with the shafts strong and large; tongue long, slender, and barbed towards, and at the tip. Generic name Latin, *Picus*, a Woodpecker.

The whole structure of the Woodpecker is admirably adapted to his mode of life. The skull is large and strong, in order to withstand the repeated shocks it receives from the forcible blows the bird deals upon the trees in pursuit of his food. The legs are stout, and the claws strong, sharp, and formed for climbing perpendicular surfaces; the breast bone has a remarkably small keel, to admit of the body being laid close to the tree, and the middle tail feathers are exceedingly strong, in order that by being pressed hard upon the rough bark, they may serve as an additional support. The wings are formed for short flights, from tree to tree, and the tongue is of extraordinary length, forming a long flexible probe or feeler, which can be thrust far into the small holes of the worms and insects, upon which the Woodpeckers feed. The point is like a slender barbed spear, with the spines directed backwards, which when thrust into an unlucky worm is sure to draw him forth from his retreat. It is furnished with a peculiar muscular apparatus, by the aid of which it can be shot out with great rapidity, and as suddenly or gradually withdrawn; and it is further provided with glands which secrete a viscid substance, that glues to its surface, any small insect with which it comes in contact.

Some ornithologists divide the family into several genera, but Audubon states that the groups present characters so undecided that it is better to consider all those of North America as of one genus. Those which we have observed in the valley of the Ottawa we shall describe in the present article, and it is probable that the species we have to notice are generally distributed over the British Provinces, being more numerous in some localities than in others.

PICUS ARCTICUS, (Swainson.)—THE ARCTIC THREE-TOED WOODPECKER.

SPECIFIC CHARACTERS.—*Three-toed, crown of the head yellow, rest of upper parts black, lower parts white; Female without yellow on the head, length 10½, breadth 16. Inhabits North America from the State of New York to the Arctic regions.*

This bird was long considered to be identical with the three-toed Woodpecker of the northern countries of Europe, but is now classified as a distinct species. Although very abundant in the Hudson's Bay Territories, and extending its range as far south as the State of New York, yet it is not numerous in Canada. Those that we have seen were in the pine forests of the Ottawa, and it is said they seek their food principally among the insects that infest the decaying trees of the pine-tribe rather than among those of the hardwoods. The circumstance that the head-quarters of the species, or the region where they most abound, is situated in the north, where the spruce, the fir, and pine, are almost the only trees, appears to support this view. De Kay, in the Natural History of New York, says it is a rare species in that State, but that he saw numbers of them on one occasion in the mountainous forests of Herkimer and Hamilton counties in June.

The following description given by Audubon will apply to nearly all the specimens :—

"Three-toed, with the upper parts glossy bluish black, the lower white, the sides and lower wing coverts transversely barred with black; tufts of bristly feathers black; crown of the head saffron yellow; a white line from behind the eye; a band of the same from the base of the upper mandible to beneath the ear coverts, succeeded by a black band; inner webs of all the quills and outer webs of the primaries spotted with white, there being seven spots on the outer and five on the inner webs of the three longest; four middle tail-feathers black, the next with an oblique band of white, the rest black only at the base, except the outermost, of which nearly all the inner web is of that colour; Female without yellow on the head."

Male 10½, 16.

Its geographical range is stated by Audubon to be, from the northern parts of New York to the Fur countries, as well as along the eastern declivities of the Rocky Mountains. Rather common, partially migratory.

A specimen which we shot in the Township of Hull, near the City of Ottawa, on the 10th of May, 1856, measured 9½ inches only in length.

Picus erythrocephalus, (Linn.)—The Red-headed Woodpecker.

Specific Characters.—*Head and neck bright crimson, that colour descending on the foreneck, and margined with a semilunar band of black; back, wings, and tail, glossy bluish black; inner secondaries, rump, and lower parts, pure white; young, with the head and neck brownish grey, streaked with dusky, edged with grey; secondary quills, yellowish white, barred with black; lower parts, greyish white; the sides, streaked with dusky. Male,* 9,17; *Female,* 8½. Audubon's Synopsis, page 184. *The specific name is from the Greek, (Erythraios,) red; and (Kephale;) the head. Breeds from Texas to Nova Scotia, and throughout the British Provinces.*

The Red-headed Woodpecker—the most common and the most observed of all the tribe in North America, subsists partly upon insects and in part upon vegetable food. Wild cherries, apples, Indian corn, and various kinds of berries constitute a portion of his food while they are in their season, and in making his selections he is known to exercise the taste and judgement of a connoisseur. The Indian corn is taken in its rich succulent milky state; and in the orchard, if you wish to find the earliest and sweetest apples, you have only to approach those trees on or near which our red-headed friend may be seen loitering. "Though this bird (says Wilson,) occasionally regales himself upon fruit, yet his natural and most useful food is insects, particularly those numerous and destructive species that penetrate the bark and body of the tree to deposit their eggs and larvæ, the latter of which are well known to make immense havock. That insects are his natural food, is evident from his wedge-formed bill, the length, elasticity, and figure of his tongue, and the strength and position of his claws, as well as from his usual habits. In fact, insects form at least two-thirds of his subsistence, and his stomach is scarcely ever found without them. He searches for them with a dexterity and intelligence, I may safely say more than human; he perceives by the exterior appearance of the bark where they lurk below; when he is dubious, he rattles vehemently on the outside with his bill, and his acute ear distinguishes the terrified vermin shrinking within to their inmost retreats, where his pointed and barbed tongue soon reaches them. The masses of bugs, caterpillars, and other larvæ, which I have taken from the stomachs of these birds have often surprised me. These larvæ, it should be remembered, feed not only on the buds, leaves and blossoms, but also on the very vegetable life of the tree—the alburnum, or newly forming bark and wood; the consequence is, that the whole branches and whole trees decay under the silent ravages of these destructive vermin. Will any one say, that taking half a dozen or half a hundred apples from a tree is equally ruinous with cutting it down? or that the services of a useful animal should not be rewarded with a small portion of that which it has contributed to preserve? We are told in the benevolent language of the scriptures, not to muzzle the mouth of the ox that treadeth out the corn, and why should not the same generous liberality be extended to this useful family of birds which forms so powerful a phalanx against the inroads of many millions of destructive vermin?"

The rich, varied and striking plumage, together with the familiar sounds and movements of this bird are among the most interesting adjuncts of the rural scenery of North America. No field is perfect without its lively family of Red-headed Woodpeckers. No traveller, with a taste for the natural, can visit the inland districts without bearing away with him a recollection of the red cap and conspicuous black and white jacket of *P. erythrocephalus.* This bird delights most in sunny fields, where there are a few trees standing, or in half cleared spots with numbers of those tall stumps in Canada, known by the elegant name of *Rampikes.* In such places, during the whole of the warmer portion of the year, you are sure to meet with numbers amusing themselves by pursuing or playing with each other. They do not seem to dread the proximity of human habitations, but on the contrary are often somewhat numerous in the immediate neighbourhood of towns and cities.—In the country they sometimes breed within two or three hundred yards of the farm house, when a tree suitable to their purpose can be found. "When alighted on a fence stake by the road or in a field, and one approaches them (says Audubon,) they generally move sideways out of sight, peeping now and then to discover your intention; and when you are quite close and opposite, lie still until you have passed, when they hop to the top of the stake, and rattle upon it with their bill as if to congratulate themselves on the success of their cunning. Should you approach within an arms length, which may frequently be done, the Woodpecker flies to the first stake or the second from you, bends his head to peep, and rattles again as if to provoke you to a continuance of what appears to him to be excellent sport. He alights upon the roof of the house, hops along it, beats the shingles, utters a cry, and dives into your garden to pick the finest strawberries he can discover." "No sooner have they satisfied their hunger, than small parties of them assemble on the tops and branches of decayed trees, from which they chase different insects that are passing through the air, launching after them for eight or ten yards, at times performing the most singular manœuvres, and on securing their victim return to the tree, where immediately after a cry of exultation is uttered. They pursue each other on wing in a very amicable manner, in long beautifully curved sweeps, during which the remarkable variety of their plumage becomes conspicuous, and is highly pleasing to the eye. When passing from one tree to another, their flight resembles the motion of a great swing, and is performed by a single opening of the wings, descending at first, and rising towards the spot on which they are going to alight, with ease and in the most graceful manner."

The nest of the Red-headed Woodpecker is placed in a hole bored in a tree by the indefatigable bill of the bird, and is not lined with leaves, feathers, or other materials, but simply enlarged to the proper dimensions, and made smooth and comfortable. The female lays six eggs of pure white, and the young are hatched in the beginning of the summer. They leave Canada for the Southern countries in the month of October, and return again in May. It is said that while upon their migrations they travel during the night and rest and feed during the day, resuming their journey again about sunset.

PICUS AURATUS, (Linn.)—THE GOLDEN-WINGED WOODPECKER OR HIGH-HOLDER.

SPECIFIC CHARACTERS.—*Upper parts greyish, and brownish spotted with black; lower parts whitish, and yellowish spotted with black; a large white spot on the rump; a crescent shaped patch of black on the breast. Length, 12½; width, 16.—Inhabits the United States and British Provinces. The specific name is from the Latin, (Auratus,) gilded, or of a golden colour.*

This very beautiful bird is common in the edges of the woods or in those fields which are not much frequented, and where there may be a quantity of old trees lying on the ground, or dead ones still standing. In such places there are generally numbers of ant-hills, to the eggs of which he is particularly partial. His food, however, varies with the season, and, as is the habit of the Red-headed Woodpecker, the young Indian corn, cherries, berries, and other fruit, are freely partaken of when they are ripe, or otherwise suitable to his palate. This bird feeds more on the ground and is more frequently seen perching upon the branches of trees than the other species of Woodpeckers. While boring the holes in the trees for their nests, the male and female work alternately, the one standing by and encouraging the other, and then taking its place. Wilson states that he has seen a hole made by a pair of these birds which penetrated, first five inches straight forward, and then downward more than twice that distance, *through a solid black oak.* The female lays six white eggs, and when the young are hatched they crawl out of the hole and take to the branches of the tree, where they are fed by the parents.

The Golden-wing is a very lively, active bird, and may be readily distinguished by the half-moon shaped spot of black on the breast, or the large patch of white on the rump, most conspicuously seen when the bird is on the wing and rising from the ground. It is rather common in Canada. Wilson gives the following account of their habits in confinement:—

"In rambling through the woods one day, I happened to shoot one of these birds, and wounded him slightly in the wing. Finding him in full feather, seemingly but little hurt, I took him home, and put him into a large cage, made of willows, intending to keep him in my own room, that we might become better acquainted. As soon as he found himself enclosed on all sides, he lost no time in idle fluttering, but throwing himself against the bars of the cage, began instantly to demolish the willows, battering them with great vehemence, and uttering a loud, piteous kind of cackling, similar to that of a hen when she is alarmed and takes to wing. Poor Baron Trenck never labored with more eager diligence at the walls of his prison, than this son of the forest in his exertions for liberty; and he exercised his powerful bill with such force, digging into the sticks, seizing and shaking them so from side to side, that he soon opened for himself a passage; and, though I repeatedly repaired the breach, and barricaded every opening, in the best manner I could, yet, on my return into the room, I always found him at large, climbing up the chairs, or running about the floor, where, from the dexterity of his motions, moving backward, forward, and sidewise, with the same facility, it became difficult to get hold of him again. Having placed him in a strong wire cage, he seemed to give up all hopes of making his escape, and soon became very tame; fed on young ears of Indian corn; refused apples, but ate the berries of the sour gum greedily, small winter grapes, and several other kinds of berries; exercised himself frequently in climbing, or rather hopping perpendicularly along the sides of the cage; and, as evening drew on, fixed himself in a high hanging, or perpendicular position, and slept with his head in his wing. As soon as dawn appeared, even before it was light enough to perceive him distinctly across the room, he descended to the bottom of the cage, and began his attack on the ears of Indian corn, rapping so loud, as to be heard from every room in the house. After this, he would sometimes resume his former position, and take another nap. He was beginning to become very amusing, and even sociable, when after a lapse of several weeks, he became drooping, and died, as I conceived, from the effects of his wound."

The following is a more full description of the plumage of this bird:—

"The Gold-winged Woodpecker has the back and wings above of a dark umber, transversely marked with equidistant streaks of black; upper part of the head, an iron gray; cheeks and parts surrounding the eyes, a fine cinnamon color; from the lower mandible a strip of black, an inch in length, passes down each side of the throat, and a lunated spot, of a vivid blood red, covers the hind head, its two points reaching within half an inch of each eye; the sides of the neck, below this, incline to a bluish gray; throat and chin, a very light cinnamon or fawn color; the breast is ornamented with a broad crescent of deep black; the belly and vent, white, tinged with yellow, and scattered with innumerable round spots of black, every feather having a distinct central spot, those on the thighs and vent being heart-shaped and largest; the lower or inner side of the wing and tail, shafts of all the larger feathers, and indeed of almost of every feather, are of a beautiful golden yellow; that on the shafts of the primaries being very distinguishable, even when the wings are shut; the rump is white, and remarkably prominent; the tail-coverts white, and curiously serrated with black; upper side of the tail, and the tip below, black, edged with light, loose filaments of a cream color, the two exterior feathers serrated with whitish; shafts, black towards the tips, the two middle ones, nearly wholly so; bill, an inch and a half long, of a dusky horn color, somewhat bent, ridged only on the top, tapering, but not to a point, that being a little wedge-formed; legs and feet, light blue; iris of the eye, hazel; length, twelve inches; extent, twenty. The female differs from the male chiefly in the greater obscurity of the fine colors, and in wanting the black mustaches on each side of the throat.

"Though this species, generally speaking, is migratory, yet they often remain with us in Pennsylvania during the whole winter. They also inhabit the continent of North America, from Hudson's Bay to Georgia; and have been found by voyagers on the north-west coast of America. They arrive at Hudson's Bay in April, and leave it in September. Mr. Hearne, however, informs us, that "the Gold-winged Woodpecker is almost the only species of Woodpecker that winters near Hudson's Bay." The natives there call it *Ou-thee-quan-nor-ow*, from the golden color of the shafts and lower side of the wings. It has numerous principal appellations in the different states of the Union, such as "High-hole," from the situation of its nest, and "Hittock," "Yucker," "Piut," "Flicker," by which last it is usually known in Pennsylvania. These names have probably originated from a fancied resemblance of its notes to the sound of the words; for one of its most common cries consists of two notes, or syllables, frequently repeated, which, by the help of the hearer's imagination, may easily be made to resemble any or all of them."

PICUS PILEATUS, (Linn.)

SPECIFIC CHARACTERS.—*General colour, dusky black; head with a crest of bright red; a portion of the wing white, but not visible except when flying; length,* 18, *breadth,* 28. *Inhabits North America to the Arctic regions. The specific name is from the Latin, (Pileatus,) wearing a cap or bonnet, in allusion probably to the scarlet crest or cap of the species.*

This is the largest species of Woodpecker to be seen in Canada, and is not very common. In February, 1852, we saw a flock of seven or eight of them in the unsurveyed lands lying between the Ottawa and Georgian Bay, and have shot several on the Bonnechere River, in the county of Renfrew. We have also seen them among the pines on the rocky hills in the Township of Hull, near the City of Ottawa. The following is Wilson's description :—

"This American species is the second in size among his tribe, and may be styled the great northern chief of the Woodpeckers, though, in fact, his range extends over the whole of the United States, from the interior of Canada to the Gulf of Mexico. He is very numerous in the Genesee country, and in all the tracts of high-timbered forests, particularly in the neighborhood of our large rivers, where he is noted for making a loud and almost incessant cackling before wet weather, flying at such times in a restless, uneasy manner from tree to tree, making the woods echo to his outcry. In Pennsylvania and the Northern States, he is called the Black Woodcock; in the Southern States, the Logcock. Almost every old trunk in the forest where he resides bears the marks of his chisel. Wherever he perceives a tree beginning to decay, he examines it round and round with great skill and dexterity, strips off the bark in sheets of five or six feet in length, to get at the hidden cause of the disease, and labors with a gayety and activity really surprising. I have seen him separate the greatest part of the bark from a large, dead pine tree, for twenty or thirty feet, in less than a quarter of an hour. Whether engaged in flying from tree to tree, in digging, climbing, or barking, he seems perpetually in a hurry. He is extremely hard to kill, clinging close to the tree even after he has received his mortal wound; nor yielding up his hold but with his expiring breath. If slightly wounded in the wing, and dropped while flying, he instantly makes for the nearest tree, and strikes with great bitterness at the hand stretched out to seize him; and can rarely be reconciled to confinement. He is sometimes observed among the hills of Indian corn, and it is said by some that he frequently feeds on it. Complaints of this kind are, however, not general; many farmers doubting the fact, and conceiving that at these times he is in search of insects which lie concealed in the husk. I will not be positive that they never occasionally taste maize; yet I have opened and examined great numbers of these birds, killed in various parts of the United States, from Lake Ontario to the Alatamaha River, but never found a grain of Indian corn in their stomachs.

"The Pileated Woodpecker is not migratory, but braves the extremes of both the arctic and torrid regions. Neither is he gregarious, for it is rare to see more than one or two, or at the most three, in company. Formerly they were numerous in the neighbourhood of Philadelphia; but gradually, as the old timber fell, and the country became better cleared, they retreated to the forest. At present few of those birds are to be found within ten or fifteen miles of the city.

"Their nest is built, or rather the eggs are deposited, in the hole of a tree, dug out by themselves, no other materials being used but the soft chips of rotten wood. The female lays six large eggs, of a snowy whiteness; and, it is said, they generally raise two broods in the same season.

"This species is eighteen inches long, and twenty-eight in extent; the general color is a dusky brownish black; the head is ornamented with a conical cap of bright scarlet; two scarlet mustaches proceed from the lower mandible; the chin is white; the nostrils are covered with brownish white, hair-like feathers, and this stripe of white passes from thence down the side of the neck to the sides, spreading under the wings; the upper half of the wings is white, but concealed by the black coverts; the lower extremities of the wings are black, so that the white on the wing is not seen but when the bird is flying, at which time it is very prominent; the tail is tapering, the feathers being very convex above, and strong; the legs are of a leaden gray color, very short, scarcely half an inch; the toes very long; claws, strong and semicircular, and of a pale blue; the bill is fluted, sharply ridged, very broad at the base, bluish black above, below and at the point bluish white; the eye is of a bright golden color, the pupil black; the tongue, like those of its tribe, is worm-shaped, except near the tip, where for one-eighth of an inch it is horny, pointed, and beset with barbs.

"The female has the forehead, and nearly to the crown, of a light brown color, and the mustaches are dusky, instead of red. In both, a fine line of white separates the red crest from the dusky line that passes over the eye."

SAP-SUCKERS.

The next three species of Woodpeckers we shall notice have been called *Sap-suckers*, the name originating in the belief of many persons that the perforations made by them in the bark of fruit trees are for the purpose of enabling the bird to extract the sap. Ornithologists in defending their favourites, stoutly deny this charge, and on the contrary contend that those trees around which so many girdles are placed by these active little birds, are usually the most healthy in the orchard. Whether they draw out the sap or not, it appears to be quite true that they sometimes destroy a good deal of valuable property. The following remark which we have met with in a paper, entitled "*Notes on the Ornithology of Wisconsin*, by P. R. Hoy, M. D., of Racine Wisconsin, published in the Proceedings of the Academy of Natural Sciences, Philadelphia, is entitled to full confidence. Speaking of the yellow bellied Woodpecker (Picus varius.) he says:—"This Woodpecker visits the orchards during September and October, to feed upon the inner bark of the peach and cherry, girdling the stems so effectually as not unfrequently to kill the trees. I have watched them while thus engaged in my own garden, and have carefully examined under a microscope the contents of the stomachs of numerous specimens." * According to this statement, the boring operation of these Woodpeckers is at least some times injurious. It is probable, however, that the damage they occasion is more than repaid by the service they render it destroying the numerous insects that prey upon our fruit trees.

The three following species are somewhat common in Canada, being more or less numerous in every part of the country. From their general black and white colours they resemble each other, but are easily distinguished after a little attention.

Picus Varius, (Linn.) Yellow-bellied Woodpecker.

Specific Characters.—*Male with the crown of the head and throat red, back black, variegated with white; lower parts yellow, a crescent of black on the fore part of the breast. Female the same, but without red on the throat; length, 8½; width, 15. Inhabits the United States and British Provinces, northward to the Sascatchewan. The specific name is Latin, (Varius,) changeable, or of divers colours or fashions.*

The Yellow-bellied Woodpecker, like most others of its tribe, bores a hole in a tree and lays its four or five white eggs in the cavity upon the bare wood. It generally, during the breeding season, retires to the more solitary woods, and is therefore not so numerous in the neighbourhood of the farms in the summer, as it is in autumn. The following is the more full description furnished by Wilson:—

"The Yellow-bellied Woodpecker is eight inches and a half long, and in extent fifteen inches; whole crown, a rich and deep scarlet, bordered with

* Proc. Acad. Nat. Sci., vol. 6, page 384.

black on each side, and behind forming a slight crest, which it frequently erects; from the nostrils, which are thickly covered with recumbent hairs, a narrow strip of white runs downward, curving round the breast; mixing with the yellowish white on the lower part of the breast; throat, the same deep scarlet as the crown, bordered with black, proceeding from the lower mandible on each side, and spreading into a broad, rounding patch on the breast; this black, in birds of the first and second year, is dusky grey, the feathers being only crossed with circular touches of black; a line of white, and below it another of black, proceed, the first from the upper part of the eye, the other from the posterior half of the eye, and both lose themselves on the neck and back; back, dusky yellow, sprinkled and elegantly waved with black; wings, black, with a large, oblong spot of white; the primaries, tipped and spotted with white; the three secondaries next the body are also variegated with white; rump, white, bordered with black; belly, yellow; sides under the wings, more dusky yellow, marked with long arrow-heads of black; legs and feet, greenish blue; tail, black, consisting of ten feathers, the two outward feathers on each side tipped with white, the next totally black, the fourth edged on its inner vane half way down with white, the middle one white on its interior vane, and spotted with black; tongue, flat, horny for half an inch at the tip, pointed, and armed along its sides with reflected barbs; the other extremities of the tongue pass up behind the skull in a grove, and end near the right nostril; in birds of the first and second year they reach only to the crown; bill, an inch long, channelled, wedge-formed at the tip, and of a dusky horn color. The female is marked nearly as the male, but wants the scarlet on the throat, which is whitish; she is also darker under the wings and on the sides of the breast. The young of the first season, of both sexes, in October, have the crown sprinkled with black and deep scarlet; the scarlet on the throat may be also observed in the young males. The principal food of these birds is insects; and they seem particularly fond of frequenting orchards, boring the trunks of the apple-trees in their eager search after them. On opening them, the liver appears very large, and of a dirty gamboge color; the stomach strongly muscular, and generally filled with fragments of beetles and gravel. In the morning, they are extremely active in the orchards, and rather shyer than the rest of their associates.—Their cry is also different, but, though it is easily distinguishable in the woods, cannot be described by words."

PICUS VILLOSUS, (Linn,) HAIRY WOODPECKER.

SPECIFIC CHARACTERS.—*Upper parts, black and white; lower parts, white; hind head, scarlet. Female same as Male, but without red on the head; length,* 9; *breadth,* 15. *Inhabits United States and British Provinces. The specific name is Latin, (Villosus,) Hairy, in allusion to the hair-like feathers on the back.*

Wilson in describing this bird, says:—"This is another of our resident birds, and, like the former, a haunter of orchards, and borer of apple-trees, an eager hunter of insects, their eggs and larvæ, in old stumps and old rails, in rotten branches and crevices of the bark; having all the characters of the Woodpecker strongly marked. In the month of May he retires with his mate to the woods, and either seeks out a branch already hollow, or cuts out an opening himself. In the former case I have known his nest more than five feet distant from the mouth of the hole; and in the latter he digs first horizontally, if in the body of the tree, six or eight inches, and then downward, obtusely, for twice that distance; carrying up the chips with his bill, and scraping them out with his feet. They also not unfrequently choose the orchard for breeding in, and even an old stake of the fence, which they excavate for this purpose. The female lays five white eggs, and hatches in June. This species is more numerous than the last in Pennsylvania, and more domestic; frequently approaching the farm-house and skirts of the town. In Philadelphia I have many times observed them examining old ragged trunks of the willow and poplar while people were passing immediately below. Their cry is strong, shrill, and tremulous; they have also a single note, or *chuck*, which they often repeat, in an eager manner, as they hop about, and dig into the crevices of the tree. They inhabit the continent from Hudson's Bay to Carolina and Georgia.

"The Hairy Woodpecker is nine inches long, and fifteen in extent; crown, black; line over and under the eye, white; the eye is placed in a black line, that widens as it descends to the back; hind head, scarlet, sometimes intermixed with black; nostrils, hid under remarkably thick, bushy, recumbent hairs, or bristles; under the bill are certain long hairs thrown forward and upward; bill, a bluish horn color, grooved, wedged at the end, straight, and about an inch and a quarter long; touches of black, proceeding from the lower mandible, end in a broad black strip that joins the black on the shoulder; back, black, divided by a broad, lateral strip of white, the feathers composing which are loose and unwebbed, resembling hairs,—whence its name; rump and shoulders of the wing, black; wings, black, tipped and spotted with white, three rows of spots being visible on the secondaries, and five on the primaries; greater wing-coverts, also spotted with white; tail, as in the others, cuneiform, consisting of ten strong-shafted and pointed feathers, the four middle ones black, the next partially white, the two exterior ones white, tinged at the tip with a brownish burnt color; tail-coverts, black; whole lower side, pure white; legs, feet, and claws, light blue, the latter remarkably large and strong; inside of the mouth, flesh colored; tongue, pointed, beset with barbs, and capable of being protruded more than an inch and a half; the os hyodes, in this species, passes on each side of the neck, ascends the skull, passes down towards the nostril, and is wound round the bone of the right eye, which projects considerably more than the left for its accommodation. The great mass of hairs, that cover the nostril, appears to be designed as a protection to the front of the head, when the bird is engaged in digging holes into the wood. The membrane which encloses the brain in this, as in all other species of Woodpeckers, is also of extraordinary strength, no doubt to prevent any bad effects from violent concussion while the bird is employed in digging for food. The female wants the red on the hind head; and the white below is tinged with brownish. The manner of flight of these birds has been already described under a former species, as consisting of alternate risings and sinkings. The Hairy Woodpeckers generally utter a loud, tremulous scream as they set off, and when they alight. They are hard to kill; and, like the Red-headed Woodpecker, hang by the claws, even of a single foot, as long as a spark of life remains, before they drop.

"This species is common at Hudson's Bay, and has lately been found in England. Dr. Latham examined a pair which were shot near Halifax, in Yorkshire; and, on comparing the male with one brought from North America, could perceive no difference, but in a slight interruption of the red that marked the hind head of the former; a circumstance which I have frequently observed in our own. The two females corresponded exactly."

PICUS PUBESCENS, (Linn.) THE DOWNY WOODPECKER.

The Downy Woodpecker very much resembles the last described species, both in habit and marking, but is always much smaller. Its length is six inches and three quarters, and its extent twelve inches; crown, black; hind head, deep scarlet; strip over the eye, white; nostrils thickly covered with recumbent hairs, or small feathers, of a cream color; these, as in the preceding species, are thick and bushy, as if designed to preserve the forehead from injury during the violent action of digging; the back is black, and divided by a lateral strip of white, loose, downy, unwebbed feathers; wings, black, spotted with white; tail-coverts, rump, and four middle feathers of the tail, black; the other three on each side, white, crossed with touches of black; whole under parts, as well as the sides of the neck, white; the latter marked with a streak of black, proceeding from the lower mandible, exactly as in the Hairy Woodpecker; legs and feet, bluish green; claws, light blue, tipped with black; tongue formed like that of the preceding species, horny towards the tip, where, for one-eighth of an inch, it is barbed; bill, of a bluish horn color, grooved, and wedge-formed, like most of the genus; eye, dark hazel. The female wants the red on the hind head, having that part white; and the breast and belly are of a dirty white.

The above seven species are all we have met with in the valley of the Ottawa, but there are several others mentioned by authors as occurring in Canada, which we have not seen. They are the following:—

PICUS CANADENSIS, (Gmel.) CANADIAN WOODPECKER.

Fourth toe considerably longer than third; fourth quill longest, fifth longer than second; bristly feathers over the nostrils dull yellow; upper part of head and hind neck, glossy black; over the eye a band of white, continuous with a transverse band of scarlet on the occiput, usually interrupted in the middle; a black band from near the bill to the eye, continued behind it over the auriculars, and joining the back of the hind neck; beneath this a white band from the angle of the mouth, curving backwards below the middle of the neck, so as to meet the other behind; then a narrow band of black from the base of the lower mandible and continuous with the black of the shoulders; upper part of the body, wings and tail, black, feathers along the middle of the back tipped with white; wing-coverts, the anterior excepted, and quills spotted with the same, there being on the four longest primaries seven spots on the outer, and five on the inner webs, on most of the secondaries five on each web, but on the outer quill only one patch on each web, and on the second three spots on the outer, and four on the inner web; four middle tail-feathers glossy black, the rest black towards the base, that colour gradually diminishing, so that the outermost is almost entirely white; lower parts white.

Extremely similar to Picus villosus, but always much larger.

Male, $10\frac{1}{2}$, $17\frac{3}{4}$.

From the northern parts of New York to the Fur Countries. Common. Migratory in winter to New York.

Audubon's Synopsis, page 177.

Picus Martinæ, (Aud.) Maria's Woodpecker.

Fourth toe slightly longer than third; fourth quill longest, third longer than fifth; tufts of bristly feathers over the nostrils, dull yellow; upper part of head, scarlet; forehead and occiput, black; a band of white over the eye; a black band from the bill to the eye, continued behind it over the auriculars, and joining the black of the hind neck; beneath this a band of white from the angle of the mouth, curving backwards below the middle of the neck, so as almost to meet its fellow behind; then a band of black from the base of the lower mandible, and continuous with the black of the shoulders; upper parts, black; feathers along the middle of the back tipped with white; wing-coverts and quills spotted with the same, there being on the four longest primaries seven spots on the outer, and four on the inner web, on most of the secondaries five on each web, but on the outer quill only one patch on each web, and on the second four spots on the outer, and three on the inner web; four middle tail-feathers glossy black, the next black on the inner web, and on the greater part of the outer toward the base, the rest black only at the base, the two outer being almost entirely white; lower parts white, tinged with grey, and a little red, the sides faintly mottled with dusky grey.

Male, $9\frac{2}{12}$; wing, $4\frac{10}{12}$.

A pair found at Toronto, Upper Canada.

Audubon's Synopsis, page 178.

Picus hirsutus, (Vieill.) Banded Three-toed Woodpecker.

Three-toed, with the upper parts deep glossy-black, the head with blue reflections, the back and wings tinged with brown; tufts over nostrils dull yellow; anterior part of head pale yellow, spotted with white; a band of white, with small dusky lines, from the angle of the mouth to the occiput; the back transversely banded with white; inner webs of the quills and outer webs of the primaries spotted with white, there being seven spots on the outer, and five on the inner webs of the three longest quills ; four middle tail-feathers black, the next white at the end, the rest white, unless at the base, but the outermost banded with black. Female with the head black, streaked with white.

Male, 9 ; wing, $4\frac{5}{12}$.

From Lake Superior to the Arctic Sea. Abundant. Resident.

Audubon's Synopsis, page 183.

PICUS CAROLINUS, (Linn.) RED-BELLIED WOODPECKER.

Male with the upper part of the head and hind neck bright carmine ; the back and scapulars transversely banded with black and white ; the rump and tall-coverts with the white predominating ; primaries black, with a band of white ; tail black, with the inner webs of the middle, and both webs of the outer barred with white ; lower parts yellowish white, abdomen red ; lower wing and tail-coverts white, spotted with dusky. Female similar, but with the top of the head ash-grey, and with less red on the abdomen.

Male, $7\frac{3}{4}$, $15\frac{3}{4}$. *Female*, 8, $14\frac{1}{2}$.

Breeds from Kentucky in the West, and from Maryland to Nova Scotia and Canada. Abundant in winter in all the Southern States, from Carolina to Texas, and especially in the Floridas.

Audubon's Synopsis, page 183.

ARTICLE XXXI.—*A Chapter on Earthquakes.*

On Thursday the 1st of May last, about twelve o'clock, noon, the City of Ottawa, and a portion of the surrounding country, experienced a shock which is believed to have been an earthquake of no great force, and confined in its effects to a limited area. In the house where we were engaged writing at the time, we first heard for two or three seconds a rolling sound like that made by a loaded waggon passing over a stony pavement, then felt a heavy jar which shook the building and threw down some wood loosely piled in the kitchen. The sound continued for a few seconds after the shock. In some of the other houses of the city the same shock was felt with more or less intensity, while in many it was not noticed. The Aylmer *Times* of Friday, published at the village of Aylmer, nine miles from Ottawa, says :—" At about half-past twelve yesterday, a smart shock of an earthquake was distinctly felt by the inhabitants of this place. Its duration was about ten seconds, sufficiently long and loud to create uneasy feelings in those who knew what it was. The atmosphere was hazy at the time, but perfectly calm thereby allowing the vibration in the houses and earth to be more clearly defined." In the country for several miles South and East of Ottawa, we have ascertained that the same phenomena were noticed at the same time. Some of the houses were even shaken with so much violence as to greatly alarm the inmates. In one, they supposed the chimney had fallen.

People in the fields did not notice anything unusual, except the sound. The atmosphere was perfectly undisturbed, and a gentleman who was walking across a field informed us that he felt no shaking of the earth, but heard what he supposed to have been two distant peals of thunder in quick succession, and which appeared to roll away towards the South. Papers published in the towns at the distance of twenty-five and fifty miles make no mention of this convulsion, and therefore while we are satisfied that it was an earthquake we think it was confined to a comparatively small extent of the earth's surface.

The cause of earthquakes is not known. There are many ingenious theories to account for the shaking of the earth, but none of them appear to be sufficient. Man is well and painfully acquainted with those terrific convulsions, but the cause which generates them appears to be situated deep down in the interior of the planet where its nature and the mode of its working can never be observed by him. We know that all motion is produced by the action of one or more masses of matter, whether animated or inanimated upon one or more other masses, and in general we can see not only the mass which moves, but also that which moves it. In an earthquake we can feel and sometimes see the ground beneath our feet in motion, but that which causes it to move we cannot see. It presents one of those problems, wherein the principal and most important facts are concealed from view. Were we possessed of the power of observing through the earth, no doubt the operations going on in the interior, would soon disclose the cause of many of the external unexplained phenomena, but as man does not possess that power, all reasoning upon the subject must, at least in the present state of our knowledge be, at best merely conjectural. During earthquakes the ground is violently shaken by quick vibrations, either upwards or sideways, or by a compound motion of such a character, that objects lying loose upon the surface are whirled round. The earth opens and swallows up cities—mountains are shaken and rent, and their fragments thrown down upon the plain, while the sea, as if frightened from its bed, rolls up over the land and washes away the ruins into its depths. At Lisbon, in 1755, a loud bellowing sound like thunder was heard underground, and in an instant afterwards the city was dashed to pieces, and sixty thousand persons killed. A great crowd of the survivors fled for safety to the quay, but that also gave way. It sank suddenly and totally disappeared, occasioning as it went down a tremendous whirlpool in the waters, which drew down a great number of boats and small vessels anchored near, full of people. Not one of the bodies, neither did any fragments of the wrecks ever rise again to the surface. The sea first retired, and then rolled back upon the shore to the height of fifty feet above its ordinary level, seizing upon and drowning hundreds of those who had escaped the earthquake and were flying about in despair, not knowing whither to go. The effects of this earthquake were felt over an area of the earth's surface four times greater than all Europe. It was noticed among the Alps, on the coast of Sweden, in the flat country of Germany, in the West Indies, in Africa, and it is also said slightly in Canada. A great wave, in some places sixty feet in height, rolled along the coast of Spain, and at Tangier in Africa, rose and fell eighteen times upon the shore. At Funchal, in Maderia, it rose fifteen feet; and at Kinsale, in Ireland, a body of water suddenly entered the harbour and whirled round, and otherwise disturbed the vessels. The waters of Loch Lomond, in Scotland, without any apparent cause, rose several feet above their usual level. Ships at sea were violently shaken. On one, the concussion was so violent that the sailors were jerked suddenly upwards to the height of a foot and a half from the deck. This latter statement appears scarcely credible, and yet Humboldt mentions one still more extraordinary. He states that "in the overthrow of the town of Riobamba in 1797, the bodies of many of the inhabitants were found to have been hurled to Cullca, a hill several hundred feet in height, and on the opposite side of the river Lican." * There surely must be some exaggeration in this instance. How could the inhabitants have been hurled up into the air unless the town were also shot up along with them?

"In the year 1692 the Island of Jamaica was visited by a violent earthquake; the ground swelled and heaved like a rolling sea, and was traversed by numerous cracks, two or three hundred of which were often seen at a time opening and then closing rapidly again. Many people were swallowed up in these rents; some, the earth caught by the middle and squeezed to death, the heads of others only appeared above ground, and some were first engulphed and then cast up again with great quantities of water. Such was the devastation, that even at Port Royal, then the capital, where more houses are said to have been left standing than in the whole island beside, three quarters of the buildings, together with the ground they stood on sank down with their inhabitants entirely under water.

"The large store-houses on the harbour side subsided so as to be twenty-four, thirty-six, and forty-eight feet under water: yet many of them appear to have remained standing, for it is stated that after the earthquake, the mast-heads of several ships wrecked in the harbour, together with the chimney tops of houses were seen projecting above the waves. A tract of land round the town, about a thousand acres in extent, sank down in less than one minute during the first shock, and the sea immediately rolled in. The Swan frigate which was repairing in the wharf was driven over the tops of many of the buildings and then thrown upon one of the roofs, through which it broke. The breadth of one of the streets is said to have been doubled by the earthquake." *

Hundreds of earthquakes have taken place, and have been recorded within the historic period, and during which all the principal phenomena were the same as in the two above mentioned. The surface of the earth in each was shaken over a greater or less extent and the sea agitated and heaped up into waves, rolled out upon the land. The phenomena of subterranean sounds do not always accompany these terrific convulsions. The great shock at

* See Humboldt's Cosmos, vol. 1, page 199, Bohn's edition.

* Lyell's Principles of Geology, 8th edition, page 486.

Riobamba in 1797, which Humboldt describes as "one of the most fearful recorded in the physical history of our planet," was not accompanied by any noise whatever. In other instances, the explosion is heard after the shock, and often the sounds are heard without the shaking of the earth. "The nature of the noise, "says Humboldt, varies also very much, being either rolling or rustling, or clanking like chains when moved, or like near thunder; or lastly, clear and ringing as if obsidian or some other vitrified masses were struck in subterranean cavities. As solid bodies are excellent conductors of sound, which is propagated in burnt clay, for instance, ten or twelve times quicker than in air, the subterranean noise may be heard at a great distance from the place where it originated." Thus in 1812 a tremendously loud noise resembling thunder, was heard over a space of 9,200 square miles in South America, unaccompanied by an earthquake, whilst at the distance of 632 miles to the northeast the volcano of St. Vincent in the lesser Antilles, poured forth a stream of lava. In 1742, on the great eruption of Cotopaxi, subterranean sounds resembling the discharges of cannon were heard at Honda, 436 miles distant. Although the precise nature of those causes which occasion earthquakes remains unknown, yet, by careful observation, many particulars concerning the direction, rate of travelling, and variations in the force of the vibrations appear to have been ascertained. If a stone be thrown into a pond of still water, the small waves produced will roll away in all directions in gradually increasing circles—becoming more feeble as they recede from the centre. The vibrations of an earthquake seem to originate from a shock given at one point and to travel away in the manner of the waves of water put in motion by the stone, but with much greater velocity. During the great earthquake at Lisbon, its waves spread across the earth's surface at the rate of twenty miles in a minute between the time the first shock was felt at Lisbon and its occurrence at other places. This velocity is greater than that of a cannon ball, and we may well imagine that the effects when passing under stone buildings would be of a violent character. Should the undulation be vertical, then the houses would be shaken upwards, but if horizontal, then their foundations would be jerked from beneath them. Were a number of light objects to be placed upon a table, and a smart blow with a hammer given to one end of the leaf, the vibrations would be lateral; but if the blow were given to the under side of the table, vertical. The articles upon the table would be shaken horizontally or vertically, according to the direction of the blow. All the shocks of earthquakes appear to be this experiment performed upon a large scale, the crust of the earth being the leaf of the table, and the cities representing the small objects upon it. The great and unanswered question is, whence does the original concussion which produces the tremblings proceed. Upon this point there are many theories. The one in which we believe is that all the effects of earthquakes are consequences of the sudden rending of the earth's interior crust. Beneath all Canada, and all the world beside, the crust of the earth, as all Geologists are aware, consists of a floor of solid rock. There is a little loose soil, a quantity small indeed, when compared to the bulk of the globe, strewn over its surface, but not sufficient to cover the whole. The rocky floor is uncovered, and peeps out in thousands of places. The dwellings we have erected are built, some of them upon the beds of loose earth and others upon the rock. Any shock given to the earth's crust as great in proportion as a blow of a hammer to an ordinary sized table, would produce vibrations sufficient to overturn or partially wreck houses consisting merely of small stones piled one above the other, and if we return to our example of the table we shall see that a fissuring of the rock would have the same effect.—Many varieties of stone will crack upon the unequal application of heat; and were the leaf of a table composed of a single slab of stone, and were heat or any other force to be so applied as to cause it to be suddenly fissured, the resulting vibrations would be quite sufficient to set all small objects upon it in motion, causing some to fly in one direction and others in a different, while still others would be whirled round, according to circumstances. What would be the effect of one of those subterranean fissures running instantaneously for hundreds of miles through the solid rocky crust of the earth? We think that vibrations more or less violent would result. The effects produced by nature with the same forces and materials are similar, no matter whether the experiment be upon a small or large scale—upon a slab of stone a yard square, or an area in the crust of the earth of the size of a continent. When the tension exerted upon a mass of rock several miles in thickness is sufficient to rend it asunder; it would be indeed strange, were no vibrations to result. The fissuring of the rock at a great depth, even although those fissures might not extend up to the surface, would most probably be felt as a more or less violent jar by the inhabitants of those countries immediately above, while the sound might also appear like subterranean thunder, and be propagated at very considerable distances.

In all geologic ages those rendings of the earth's surface have been of frequent occurrence, and thousands of ancient cracks can be seen in every rocky region, to occasion any one of which would require a convulsion equal to a modern earthquake. Some of those fissures may be traced for a great many miles, and, although in general, the rock on each side still remains in its original position, and the parts in contact, yet in a large proportion of the instances, the fissure is several feet or yards in width, and filled up with new material, often veins of metallic ores. In many cases the country on one side has sunk down to a greater or less depth, while the other remains at its original level, thus producing what the miners call a "*Fault*," a word which has been adopted as a technical term in geology. There is no formation which is not traversed by these fractures, and they may be seen in all countries, thus proving that the whole surface of the earth has been subjected in all ages to convulsions caused by the action of forces pent up in its interior.

We have no reason to believe that the causes which have operated so powerfully in ancient times to fissure the earth's crust, have ceased to exist. We are as yet in total ignorance of their nature, and for aught we know all those old catastrophes may yet be shewn to have been occasioned by the most ordinary operations of nature, and to be necessary to preserve that universal order which prevails throughout the planetary system. Although according to the strict rules of science, we are not permitted to reason, except upon facts actually observed, yet to a certain extent, we may indulge in conjectural speculations. These, although they often lead to error, yet sometimes guide to truth.

Granting that earthquakes may be caused by the occasional fissuring of rocks in the subterranean depths, it has next to be shewn by what force these fractures have been, and still are produced. Upon this point also we have no knowledge from direct observation. If the interior be subject to an intense heat sufficient to melt the hardest rocks, then it must be in a fluid or viscid state. The facts that as we descend, the temperature increases —that wherever there are openings through the surface, melted matter oozes out, and that great elevations and depressions of land which could not well occur, were the earth solid like a cannon ball, have been common in all ages, seem to demonstrate that; not only is the interior in a fluid state, but that the exterior crust is of no great thickness. Many mathematicians are of a contrary opinion, but notwithstanding all manner of calculations, the facts still remain. We do not believe that the myraids of short flexures to be seen in the Laurentian rocks of Canada could have been produced upon the surface of a planet, solid through to the centre, or even to the depth of twenty miles. And if such be the structure of the interior, then any fluctuations of the viscid mass within would cause movements of the exterior, elevating some portions—depressing others—straining the rocky covering, and now and then rending it asunder. The following passage from Sir John Herschel's writings, although not much regarded by Geologists, has always appeared to us to contain within it the explanation of nearly all the phenomena of earthquakes and volcanoes. While upon the subject of the constitution of the Sun, he says: "The Sun's rays are the ultimate sources of almost every motion which takes place on the surface of the earth. By its heat are produced all winds, and those disturbances in the electric equilibrium of the atmosphere which give rise to the phenomena of terrestrial magnetism. By their vivifying action vegetables are elaborated from inorganic matter, and become, in their turn, the support of animals and of man, and the sources of those great deposits of dynamical efficiency which are laid up for human use in our coal strata. By them the waters of the sea are made to circulate in vapour through the air, and irrigate the land, producing springs and rivers. By them are produced all disturbance of the chemical equilibrium of the elements of nature, which, by a series of compositions and decompositions, give rise to new products and originate a transfer of materials. Even the slow degradation of the solid constituents of the surface, in which its chief geological changes consist, and their diffusion among the waters of the ocean, are entirely due to the abrasion of the wind, rain and tides, which latter, however, are only in part the effect of solar influence and the alternate action of the seasons; and when we consider the immense transfer of matter so produced, the increase of pressure over large spaces in the bed of the ocean, and diminution over corresponding portions of the land, we are not at a loss to perceive how the elastic power of subterranean fires, thus repressed on the one hand and relieved on the other, may break forth in points when the resistance is barely adequate to their retention, and thus bring the phenomena of even volcanic activity under the general law of solar influence."

The remarks in the above quotation concerning the "transfer of matter," appears to us to be of great importance in treating upon the causes of earthquakes. All the great formations of rock of a secondary origin consist of matter which does not occupy at present its original position upon the surface of the earth. The sedimentary rocks of North America are, in Pennsylvania, about four miles and a half in thickness, or in other words that part of the earth's surface is covered with a sheet of solid rock four and a half miles thick, the material of which has been transported from some other place. The effects of this enormous "transfer of matter" should have been the same as if the continent of North America were to be taken up bodily to the depth of four and a half miles and laid down upon the surface of Europe. If it be true, as many geologists suppose that the interior of the earth is in a semi-fluid state, it is probable that the addition of this enormous load of rock to the surface of Europe would cause the crust to sink down in that part of the world and force the subjacent fluid matter away under other regions, which would be elevated in consequence. The effects would be no doubt felt all over the world. New countries would rise up out of the sea, volcanoes would burst forth and all the present arrangements of land and water upon the face of the globe be changed. The consequences would be nearly the same, were the transfer to be made gradually instead of all at one time. Were one foot in thickness of rock only to be laid upon the surface of Europe in a thousand years, and were the process of accummulation to continue for a sufficiently great period of time, the burden would in the end become too great to be sustained, and a sinking of the surface must take place. The effects, instead of occurring all at once in one grand and general convulsion affecting the whole earth's surface, would be distributed piecemeal throughout many ages, and save, by a slight shudder now and then,, indicating that some stratum of rock far beneath the surface had given way, would be imperceptible. Still, although the process might be slow yet it would be sufficient to occasion all the earthquakes, volcanoes, elevations and subsidences of land that have been noticed in historic times, or which can be shewn to have taken place in former ages.

The suggestion of Sir John Herschel, however, would only explain the phenomena of earthquakes, were it true that the interior of the earth is in a fluid state. Many facts, such as the increase of heat in deep mines, the rising and sinking of land, and the molten overflowings of volcanoes, seem to demonstrate that such is the condition of the interior; but, on the other hand, some of the most eminent mathematicians have carried through certain calculations of great complexity which appear to prove that either it is solid throughout, or that the crust is of such great thickness and strength that the transfer of very considerable masses of matter upon the surface would procedue little effect. We shall probably in a future article give some account of these calculations.

ARTICLE XXXII.—*On some of the Common Rocks of the British Provinces.*

The student of nature in the country, who must depend upon reading and his own observation for the acquisition of a knowledge of the science of geology, should first learn to recognise those minerals and rocks which are the most abundant, and afterwards proceed to the study of those more rare. In the following article we shall point out a few of the former, and give some general accounts of their distribution compiled from such sources as we have at our command.

There are a few simple minerals which, by their various combinations, constitute the principal part of all the rocks visible upon the surface of the earth, and when a person has learned to know these at sight, he has made an important progress in practical geology. Thousands of square miles of the British Provinces are covered with masses of rock composed altogether of the five minerals, quartz, felspar, mica, hornblende, and carbonate of lime. The latter constitutes all the limestone of the country, while of the other four are composed nearly all those hard rocks, usually, but incorrectly called granite, which may be seen in the hilly regions on the northern frontier of the settlements, extending from the mouth of the St. Lawrence to the Georgian Bay. Granite is comparatively rare throughout the greater portion of Canada, although another rock which closely resembles it, and is composed of the same ingredients, is the most abundant of all, either in mountain masses or strewn in rounded boulders or angular blocks over the surface. This latter is *gneiss*, of which there are many varieties, all however composed principally of quartz, felspar, hornblende, and mica, combined in very variable proportions. Of this rock, we shall give a more particular account hereafter.

Of the minerals above mentioned, QUARTZ is one of the most common, and forms one of the principal ingredients in the structure of the hard crust which constitutes the exterior covering of the earth. It is generally of a white colour, and sufficiently hard to scratch glass or give fire with steel.—In fact, all the gun-flints once in use consist of a greyish or blackish variety of quartz. The fragments of white mineral often picked up in the fields and used for striking fire are quartz. Grains of quartz of greater or less size, and often veins of it, may be seen in nearly all the boulders near the southern margin of the Laurentine formations, while the great masses of rock which constitute the rugged hills of those portions of the Province where this extensive formation prevails, have often one fourth of their whole bulk composed of it.

Although the most common colour of quartz is milk white, yet it is often perfectly transparent or of various shades of white, yellow, red, or violet, and it is variously called *granular quartz, smoky quartz, fetid quartz, brown* *quartz, rose quartz, ferruginous quartz, violet quartz,* or *amethyst,* according to its structure or appearance.

The most certain methods of deciding as to whether a particular specimen is quartz or not is to try it with glass and steel. If a fragment of mineral be white or transparent, and it will scratch glass and give sparks to steel, it may be pretty safely labelled as quartz.

Felspar somewhat resembles quartz in external appearance, being often white, and sometimes semi-transparent. It is however of an inferior degree of hardness and may be scratched with the point of a well tempered knife, while quartz is so hard that steel makes no impression upon it. It is of various colours, white, grey, yellow, blue, green, or red. It has generally a pearly lustre, and breaks up into rhomboidal fragments, a form never assumed by quartz in its fracture. Among the Laurentian rocks, and in the boulders derived from this formation specimens of felspar may be readily procured in this shape, and by frequently observing these, the eye will soon become familiar with the external appearance of the mineral with respect to its lustre, forms of cleavage, &c. When felspar and quartz of the same colour, however, are confusedly mixed together in small grains, they cannot be distinguished unless by an experienced eye without resort to other methods which we shall notice hereafter.

Mica is easily recognised. It is a mineral remarkable above all others for the facility with which it may be divided into thin leaves. It is often, though improperly called Isinglass. It is generally of various shades of yellow and brown. Very thin flakes are transparent. Large sheets of it are used by the Russians for windows in their ships, the advantage being, that while by reason of its transparency it serves the purpose of glass, yet, as it is exceedingly tenacious, it cannot be broken by the concussions resulting from the discharges of heavy artillery. It is also used for lanterns, and as heat does not destroy it, for stove doors. This mineral occurs in the gneiss and limestone of the Laurentian rocks in small scales or specks, or in crystals from one eighth to several inches in diameter, preserving however its lamellar character.

Hornblende is dark bottle-green or brownish green, or brown approaching to black, but when pulverized, of a greenish grey. Its lustre is vitreous or glassy, and it yields pretty easily to the knife. When in considerable masses it is tough, and is not easily broken like the brittle species. It is a very abundant mineral, being an essential ingredient of various species of rocks and is found in most countries.

The above four minerals by their combinations constitute a vast proportion of all the harder kinds of rock in Canada. Some idea of their abundances may be formed by taking a general view of the geographical extent of the Laurentian formation. This great system of rocks constitutes an irregular belt from one hundred to three or four hundred miles in width extending from Labrador to the country lying north of Lake Superior, a distance of more than a thousand miles. In its course it makes a deep bend towards the south and sends out a projection which crosses the St. Lawrence between Brockville and Kingston, and penetrates the State of New York to the neighbourhood of Lake Champlain. The whole of this vast tract of country consists almost altogether of stratified rocks composed of these four minerals, quartz, felspar, mica, and hornblende, with here and there a band of white crystelline limestone. Were all the forests and all the loose soil to be swept away from the formation, so that the actual solid crust of the globe could be seen, and were a spectator to be so placed above the earth that he could take a bird's-eye view of the whole region at one glance, the surface would appear to him to be constituted of multitudinous thin leaves of rock twisted and folded in every direction. These leaves would be the strata of gneiss, schist, or limestone, which form the great mass of the Laurentian system, and their twistings and foldings the effects of the ancient convulsions of nature by which they, although of the strongest rock, have been shrivelled up as a scroll.

The most abundant rock of the Laurentian system is what is called *Syenitic gneiss,* and in order to shew wherein this differs from granite, we shall give the following description of the origin and composition of these and a few others that will frequently be met with in Canada.

Granite.—This rock is composed of quartz, felspar, mica, and sometimes hornblende, and is of several varieties, such as—1st. *Granite,* properly so called, consisting of quartz, felspar, and mica. 2nd. *Graphic granite,* composed of quartz and felspar only, but so arranged as to produce an irregular laminar structure. When cut and polished in a direction across the plates of quartz and felspar, of which it consists, the surface of graphic granite appears to be covered with Hebrew letters inlaid and blended into the substance of the rock. Hence its name :

3rd. *Porphyritic granite,* which, in addition to the usual ingredients, contains distinct large crystals of felspar.

4th. *Syenitic granite,* composed of all four of the minerals, quartz, mica, and hornblende.

There are numerous other varieties, but the above are all we need notice for our present purpose, and they are all supposed to have been once in a fluid state and to have become consolidated by cooling. The true geological position of granite appears to be beneath every other species of rock, although it is often seen upon the surface, having been ejected, while fluid, thrust up through the others in solid masses, or uncovered by the removal of the once overlying formations. Sir Charles Lyell says, "all the various kinds of granite which constitute the plutonic family, are supposed to be of igneuos origin, but to have been formed under great pressures at a considerable depth in the earth, or sometimes, perhaps under a certain weight of incumbent water. Like the lava of volcanoes, they have been melted, and afterwards cooled and crystalised, but with extreme slowness, and under conditions very different from those of bodies cooling in open air." A large proportion of the interior of the earth may therefore be granite; probably solid towards the surface where it supports the stratified rocks and fluid below. Pluto, a god of the ancients, was said to be the king of the lower regions, and hence the granites are called Plutonic rocks, because they most abound and come up from his dominions to us upon the surface.

Granite is not stratified, but the rocks we are next to consider, although composed of the same ingredients, are disposed in regular layers from one inch to several feet in thickness, and it is these with which the student of Canadian geology will most frequently meet as they extend over the whole of the Laurentian country.

They consist of the different varieties of gneiss and schist.

1st. *Gneiss* is composed of quarts, felspar, and mica, stratified or arranged in regular beds.

2nd. *Syenitic gneiss* consists of the same materials, but with the addition of hornblende. This rock largely abounds in Canada, constituting the principal portion of the Laurentian formation. The principal difference between gneiss and granite is, that the latter is a rock of igneous origin, while the former is composed of materials deposited upon the bottom of the ancient oceans—and there consolidated. The Laurentian formation was therefore accumulated in a sea of still greater antiquity than that in which the Potsdam Sandstone was deposited. Boulders or beds of Gneiss may in general be recognised by their striped appearance. They often consist of alternate thin layers of quartz, felspar, and mica, and these minerals being of different colours the sides of the rock which present the edges of the respective laminæ exhibit numerous stripes of white and black, or of lighter and darker colours. There is thus a sort of double stratification of gneiss. In the first place the formation is divided into strata, from one inch to three or four feet, and even twenty feet in thickness, totally separated from each other, and in the second place each bed consists of numerous laminæ or thin leaves, from one eighth of an inch or less to several inches in thickness, blended together.

If the observer can see that a piece of rock is composed of quartz, felspar, and mica, and also that these ingredients are not uniformly mixed throughout, but arranged in alternate thin leaves, then he may be certain the specimen is gneiss in some one of its varieties.

Syenite is a name given to a variety of rock obtained from the quarries of Syene, in Egypt. It consists of quartz, felspar, and hornblende, but no mica. When hornblende is present in granite, the rock is called *Syenitic granite*, and when this mineral also occurs in gneiss, it is called *Syenitic gneiss*.

In the Laurentian formation the Syenitic gneiss is often of various shades of grey, and much resembles grey granite. Great masses may often be seen of a red colour, owing to its being largely composed of red felspar. Other varieties are almost black, from the great proportion of dark blackish green, hornblende, or mica they contain. These latter varieties also pass into schist, which is thus described by Sir Charles Lyell.

"*Hornblende schist* is usually black, and composed principally of hornblende, with a variable quantity of felspar, and sometimes grains of quartz. When the hornblende and felspar are nearly in equal quantities, and the rock is not slaty, it corresponds in character with the greenstones of the trap family, and has been called primitive greenstone. It may be termed hornblende rock. Some of these hornblendic masses may really have been volcanic rocks which have since assumed a more crystalline or metamorphic texture.

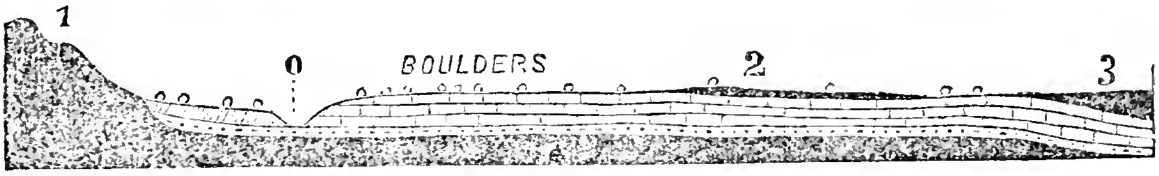
" *Mica-schist*, or *Micaceous schist*, is next to gneiss, one of the most abundant rocks of the metamorphic series. It is slaty, essentially composed of mica and quartz, the mica sometimes appearing to constitute the whole mass. Beds of pure quartz also occur in this formation. In some districts garnets in regular twelve sided crystels form an integrant part of mica schist.

The great bulk of the Laurentian rocks consists of the above three species *Syenitic gneiss*, *Hornblende schist*, and *Mica schist*.

But in addition to these, the formation also includes many beds of white limestone, a rock identical in composition with the white marble, so much used for tombstones and other purposes in Canada and the neighbouring States. The white limestone is interstratified with the syenitic, gneiss, and other rocks. In some localities there may be seen hills of rock composed of beds of the limestone and syenitic gneiss, alternating with each other through a great thickness of strata. Sometimes there will be a single layer of limestone then a stratum of gneiss, then another of limestone, and so on for many yards in depth; but usually from twelve feet to several hundred feet in thickness of each deposit is found without any intermixture of the other.

The limestone is usually white, but often striped with grey bands. It is also at times somewhat reddish or flesh coloured, and frequently, as do many of the Laurentian rocks, contains crystals of other minerals. Of these, we shall, in some future article, give more full particulars.

The following wood cuts are intended to exhibit the manner in which the above mentioned rocks underlie the Silurian and higher formations in Canada.



Section from North to South across the River Ottawa, East of the City of Ottawa.

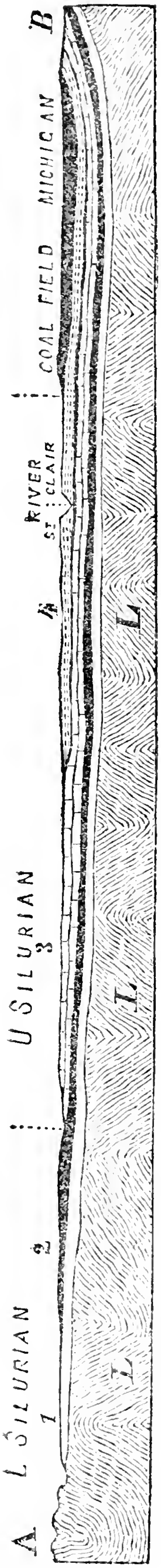
A geological section shews the structure of the earth's crust in any particular place where the section will apply to a certain depth. In the above section the structure of the country on the Ottawa river lying on both shores of the stream, and to the depth of nearly a mile, is intended to be shewn. The black mass at the figure 1 represents the ridge of low rocky hills usually seen near the north shore of the river. They consist in general of Syentic gniess interstratified with white crystalline limestone extending southwardly at a lower level under the Silurian rocks which repose upon them in following order. 1st. The Potsdom Sandstone represented by the dotted band lying above black. 2nd. The Calciferous Sandrock shewn by the lowest of the three bands, with the upright joints. 3rd. The Chazy

Bird's-eye, and Black River Limestones, all included in the next band. 4th. The Trenton Limestone which constitutes the surface where the boulders are represented. 5th. The Utica Slate indicated by the black patches at figures 2 and 3. At the point 0, the Ottawa has worn out a deep channel down to the Potsdam Sandstone. Between the cavity of the stream and the hills, there is usually a bed of drifted materials, composed of sand, clay, or gravel, with boulders. Similar beds are generally seen on both shores, and in fact, spread over the whole country.

At the City of Ottawa the channel of the river is wholly excavated in the Trenton Limestone, which occupies both shores and constitutes the cliffs and islands at the Chaudiere Falls. At the Chatts, on the other hand, the Laurentine rocks cross the river from the north towards the south, and are seen on both banks of the stream to a point a short distance above the mouth of the Madawaska when the Trenton Limestone is again seen occupying the south shore at different points for some distance above Sand Point. From the Bonnechere to the upper extremity of the Calumet Island, the Laurentian rocks form the banks and obstructions of the river.

It appears probable that the range of hills that may be seen running along or near the north shores of the St. Lawrence, from its mouth to above Quebec, and thence still further west along the north side of the Ottawa is to be considered the shore of an ancient ocean. A person perched upon the summit of one of those hills at the point 1, in the above figure for instance, and looking south towards 2 and 3, may survey a vast tract of level country situated several hundred feet lower than the rocky pinnacle on which he may be standing. From such a position, he would be looking over the wide flat valley of an ancient ocean, whose waters long since withdrawn, have left as mementos of their former presence—the beds of Silurian rocks composed principally of the remains of the myriads of creatures that once enjoyed life in that sea. Were the water to be withdrawn from the Atlantic, those living upon the shore might descend into the deserted cavity, people the newly desiccated country, and cover it over with smiling fields and thriving towns. They might dig up from the soil the remains of the various marine animals, study their structure, and exhibit them in museums for the gratification of the curious. The Natural History of the Atlantic could then be ascertained long after the ocean, and all its tenants had ceased to exist. And, it is thus, that the greater number of the inhabitants of Canada are living in the bed of an ocean, of which the fossils accumulating in our museums are the organic remains.

The next figure is a section across Western Canada from the County of Victoria, passing westerly through the Counties of Ontario, York, Peel, Wellington, Waterloo, Oxford, Middlesex, Lambton, and into the State of Michigan. It is scarcely necessary to observe that the section is only a rough outline exhibiting the geological structure of the country in a very general way. At the point A in the County of Victoria, are seen the Laurentian rocks. They constitute the bottom in the direction indicated by the letters L L L westerly. Upon them repose 1 and 2 the Lower Silurian, 3 the Upper Silurian, and 4 the Devonian formations, which



Section across Western Canada from the County of Victoria into the State of Michigan.

latter cross the river St. Clair and support the coal field in Michigan These formations here shew all their subdivisions, such as the Trenton Limestone, Utica Slates, Hudson River Groups, &c., mentioned in the first article of this journal. They are not indicated in the section, only the relative positions of the larger groups being shewn.

The section explains the meaning of the expression frequently used, "that Canada is too low for coal." In the Laurentian formation indicated by the letters L L L, or in rocks of equivalent age in other countries, no coal has ever been found. It will be seen in the section that these rocks, as well as the Silurian and Devonian, run under the true coal measures, and although they occupy the surface in some of the most elevated portions of the earth; upon the Himalaya Mountains for instance, yet geologically they are below the Carboniferous series of rocks.

The black band 2 in the section is intended to represent that portion of the Lower Silurian in which the dark coloured or black bituminous shales of the Utica Slate and Hudson River Groups prevail. These substances, on account of their being inflammable to a small extent, have often been mistaken for coal. They abound in the country lying east and north of Toronto, and it is not long since their fitness for the purposes of fuel was brought prominently before the public. The formation 2, however, as may be seen in the section, runs under the coal measures of Michigan, and is so well known that it may be safely affirmed that no coal will ever be found in it, although some of the beds, on account of their containing small quantities of bitumen, an inflammable substance, will, when placed upon a hot fire, give forth flame.

The rocks at Quebec in which coal has been stated to exist, are exactly the same as this formation No. 2, the Utica Slate and Hudson River group, and if a section similar to the above were to be carried south easterly to Nova Scotia, the same series of formations would be indicated. Where the section would cross New Brunswick, the coal would be found lying above the Quebec rocks in the same manner that the coal of Michigan is seen in the figure lying above the shale, which crops out in the country lying north of Toronto. In another article we shall pursue this subject further, and give some additional illustrations.

ARTICLE XXXIII.—*On some of the Lower Silurian Fossils of Canada.*

The following are some of the most common Fossils which occur in the Lower Silurian Rocks of Canada :—

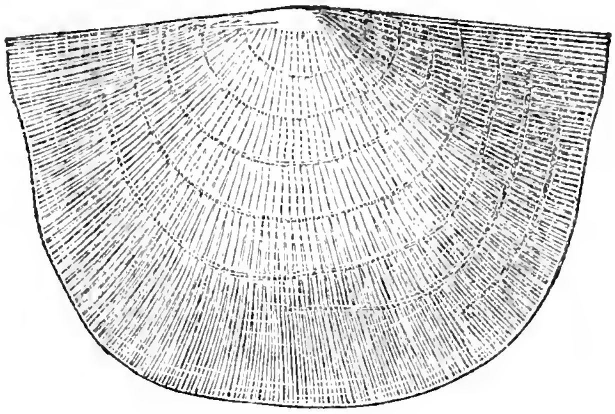


Fig. 1.—*Strophomena filitexta,* (Hall.)

The above figure exhibits the dorsal or convex valve of a very fine shell which occurs in the Trenton Limestone in great numbers at *Little Chaudiere Falls,* near the City of Ottawa,—at the 4th Chute of the Bonnechere, in the County of Renfrew, and at the lower end of the Allumette Island, opposite the Township of Westmeath, in the same county.

This species is of a semi-oval shape, and regularly convex or rounded from near the centre of the dorsal valve the highest point being a little nearer the hinge line than the centre. The ears are somewhat deflected or flattened. The ventral valve is regularly concave. The area is very large on the ventral valve, and the foramen nearly closed by a deltidium. The area is small on the dorsal valve. The surface is covered with fine rounded striæ crowded close together, and crossed by fine concentric lines. In some specimens in our possession which appear to belong to this species, there are coarser striæ at regular intervals, with six or seven of the smaller ones between.

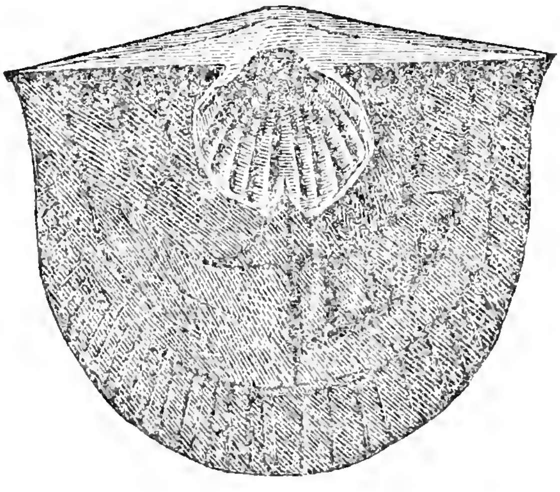


Fig. 2.—*Strophomena filitexta, interior of ventral valve.*

Fig. 2 shews the large " saucer-shaped" muscular cavity which forms the distinguishing character of the genus Strophomena. In the specimens we have seen, the ridges in this cavity are not so conspicuous as they are in this figure, which is taken from Hall's Palæontology. The length of the hinge line or the straight side of this fossil is from an inch and a half to two inches, while the height from beak to base is from one inch to an inch and a half. The specific name appears to be from the Latin, *filum*, a thread, and *textum*, woven, in allusion to the woven appearance of the striæ on the shell. This character is not always clearly seen. This species occurs only in the Trenton Limestone, and is most numerous at the base of the formation—rarely in the upper part. For the technical terms used in this article, (see articles 18 and 19.)

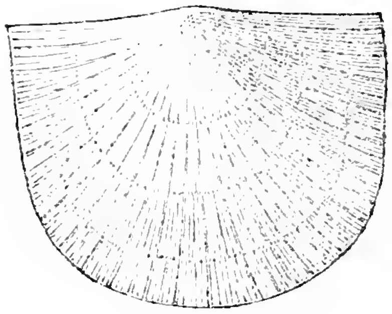


Fig. 3.

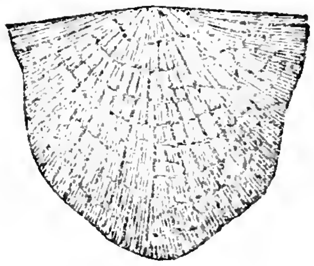


Fig. 4.

Figs. 3 and 4.—*Strophomena alternata*, (Conrad.)

This species is one of the most common and frequently quoted of the brachiopoda of the Lower Silurian rocks, and it is one of the most variable in form. It is found both in England and America, and we shall therefore give the descriptions of the palæontologists on both sides of the water, in the hope that from the two the species may be recognized with the more certainty.

Professor Hall says that this shell is "broadly semi-oval; length and breadth about as 12 to 15; hinge line, in perfect specimens, a little longer than the width of the shell, slightly reflected at the extremities, which sometimes become short acute ears; cardinal area narrow, the callosity of the ventral valve, nearly filling the triangular foramen of the dorsal valve; beak uniformly perforated with a minute circular opening; dorsal valve, depressed convex, sometimes more convex in the middle, suddenly deflected near the margin, and flattened towards the cardinal line; ventral valve concave, gradually or sometimes suddenly inflected towards the basal margin; surface marked by five rounded radiating striæ, which alternate at unequal intervals with coarser ones; striæ increasing in numbers towards the margin of the shell, crossed by fine elevated concentric lines and a few imbricating lines of growth.

"In this species the striæ are usually of two sizes, the coarser and more elevated ones having from four to six finer ones between them, the latter increase in number as they recede from the apex, and one of them in the centre of the fascicle becomes enlarged, and rises above the others. Some of the specimens figured are strongly marked individuals where these characters are very distinctly preserved; but there are many variations from the type of the species, and some others where it is difficult to decide their true relations when we have not a series shewing their gradations."

Palæontology of New York, vol 1, page 102.

Professor McCoy in describing the English specimens, says:—"This species is longitudinally, semi-elliptical, or transversely subquadrate; receiving (ventral) valve gently convex along the middle, with a very short mesial sulcus close to the beak, gently deflected at the side margins when old; entering (dorsal) valve flat, or slightly concave, cardinal area very narrow, inclined back at about 120°, surface of both valves radiated with very fine linear thread-like striæ, separated by equally wide, flat, coarsely punctured spaces, when partially decorticated; striæ thicker and closer together, when the surface is preserved; striæ of two, more or less distinct sizes, usually three of the finer, between each pair of the larger; the middle subsequently increasing in size, and a new pair of small striæ being intercalated on each side; about eighteen striæ in the space of two lines, at six lines from the beak; interior of the valves marked with radiating external striæ, and with very numerous obtuse granules, nearly corresponding with the external punctures."

Sedgewick and McCoy's Palæozoic Rocks of Great Britain, page 233.

This species is found in the Trenton Limestone abundantly, and also in the Hudson River group. The specific name is from the Latin *Alternatus*, meaning alternated or changed by turns, in allusion to the different sizes of the striæ. It was originally placed in the genus *strophomena* by the American geologists. Afterwards called a *leptena*, both in Europe and America, but since the recent more extended observations upon the internal structure of these fossils, the genus Strophomena, as mentioned in a previous article, has been restored. The terms receiving and entering valves, made use of by Professor McCoy, are the equivalents of ventral and dorsal valves, as now more generally used. When the Palæontology of New York was written, these latter two terms were reversed in their meaning, which accounts for the brackets in the above quotations.

Leptena deltoidea is another fossil very like *S. Alternata* above figured. Its principal differences consist in its being usually more convex and pointed in front, like Fig. 4, than rounded below, like Fig. 3. There are, also, in most good specimens, a number of concentric wrinkles on the surface of the shell. We have not yet ascertained whether this fossil should be called a *Leptena* or a *Strophomena*. It occurs in the Trenton Limestone in many localities. The specific name is founded upon the form of the fossil, approaching the triangular shape of the Greek letter *delta*.

Orthis pectinella has the ventral valve flat towards the margin, and the dorsal valve convex, most prominent in the centre. The ventral valve has a low area, which is almost at right angles with the plane of the shell. The surface is marked by from 22 to 30 prominent, rounded, radiating ribs, with wide spaces crossed by small elevated concentric lines. This shell, when perfect, so that the ribs and concentric lines are well shewn, is a very pretty and neat fossil. There are several others, which are either varieties of this or else closely related species. It occurs in the Trenton Limestone. The specific name is Latin, *Pectinella,* a little comb.

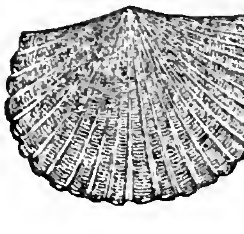


Fig. 5.

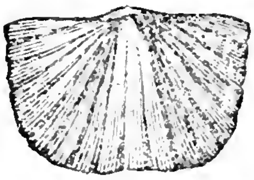


Fig. 6.

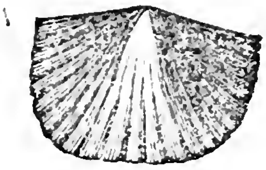


Fig. 7.

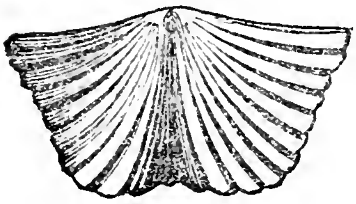


Fig. 8.

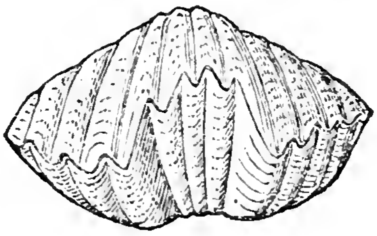


Fig. 9.

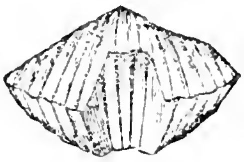


Fig. 10.

Fig. 5.—*Orthis pectinella.* Figs. 6, 7, 8, 9, and 10.—*Orthis Lynx.*

Orthis Lynx, (Eichwald) commonly called *Delthyris* or *Spirifer lynx,* is a very common fossil in the Trenton limestone, at the City of Ottawa. Its form is exceedingly variable, but it is, notwithstanding this, easily recognized in all its shapes. The hinge line is straight, and often prolonged so as to form short, acute ears. Its outline is semi-elliptical, or sub-quadrate, and its surface bears a number of very strong radiating ribs. The ventral valve has a deep sinus in which there are three or four ridges, while the dorsal valve shews a corresponding mesial fold with four or five ribs. Figs. 9 and 10 are views of the bottom of the fossil, shewing the large sinus in the margin. The beaks are about equally incurved, and the area is narrow, a little largest on the ventral valve. This fossil, usually, has both valves very much curved, and, in consequence, it sometimes approaches a globular shape. It has more the appearance of a *Spirifier* than of an *Orthis,* (see the figures of *Spirifer radiatus, S. Sulcatus,* and *S. Niagarensis,* Plate 2, in the 2nd number of this Journal, Figs, 3, 7, and 8) and it was until lately, most commonly known as *Spirifer lynx.* It is now, however, considered to be an *Orthis.* No species of *Spirifer* is described as existing in the Lower Silurian rocks of North America, in any of the books within our reach, and this shell, therefore, when met with in the Trenton limestone, is easily recognised, as it is the only fossil in the formation which presents the ears and other general external characters of that genus. The specific name was probably derived from the resemblance which some of the specimens bear to the head of a *Lynx.* The fossil is so variable in its form, that the figure of one specimen will not closely resemble others found in another locality, and therefore we have given a number from all of which the general idea of the species may be formed.

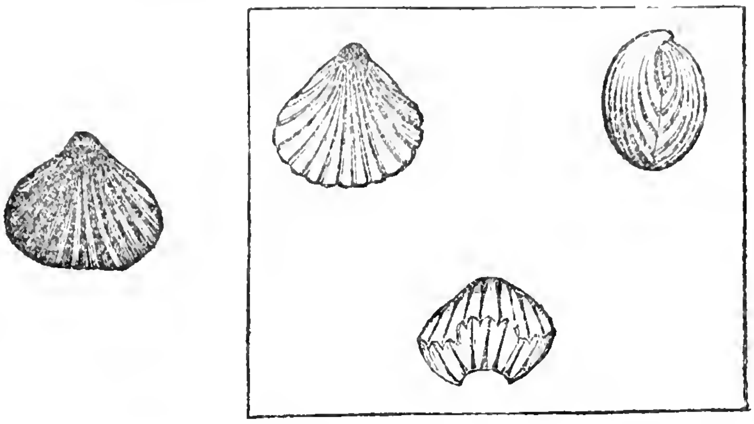


Fig 11. Fig. 12. Fig 13. Fig. 14.

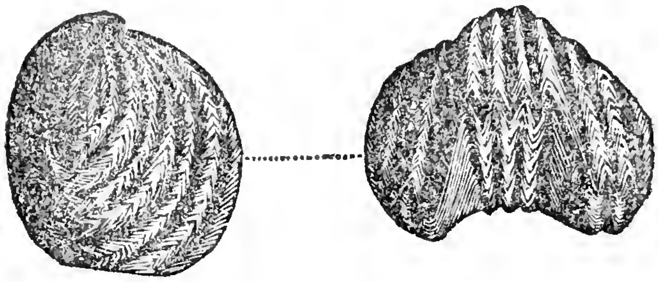


Fig. 15. Fig. 16.

Figs. 11, 12, 13, 14, 15, 16.—*Different specimens of Atrypa increbescens.*

Atrypa increbescens may be considered the characteristic species of this genus for the Trenton Limestone, as it occurs abundantly in the rock in numerous and widely separated localities, shewing that it swarmed throughout the sea, which, during the period when this formation was deposited, covered all the middle portion of North America. This shell varies greatly in form, according to the age of the specimen. The young individuals are somewhat oval or triangular, and flat with the mesial fold and sinus, little developed. The old specimens are globular, and approaching the shape of figures 15 and 16. The dorsal or shorter valve has a deep sinus, with three or four ribs in the bottom, while the ventral valve has an elevated fold, with four or five. The number of radiating ribs is usually fifteen. The beak of the ventral valve is in the younger specimens acute and erect, slightly incurved at the point, but in the old shells closely hooked over the apex of the dorsal valve. The radiating ribs are never subdivided, but continuous from the base to beak, becoming more slender as they proceed upward.—They are crossed by imbricating zig-zag elevated lines, as seen in Figs. 15 and 16. This character, however, is only seen in perfectly preserved shells. Specimens are abundant, with the ribs well developed, but with little trace of those lines. This species occurs in the Trenton Limestone.

Atrypa plena is a fossil which occurs abundantly in certain layers of the chazy limestone, and very closely resembles *A. increbescens.* The number of plications or radiating ridges is, however, from 16 to 20, while *A. increbescens* has, at the most only about 15. The ridges are also shar per, and they are not crossed by the imbricating lines of the former species. There are four or five ridges in the bottom of the ventral sinus, and five or six on the mesial fold. We have seen some beds of limestone composed of a dense mass of these fossils, packed closely together and well preserved. *Plenus*, Latin, full, large or plentiful.

Fig. 17.

Fig. 18.

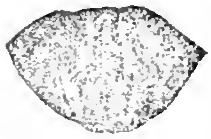


Fig. 19.

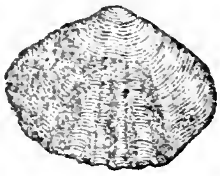


Fig. 20.

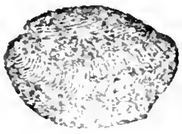
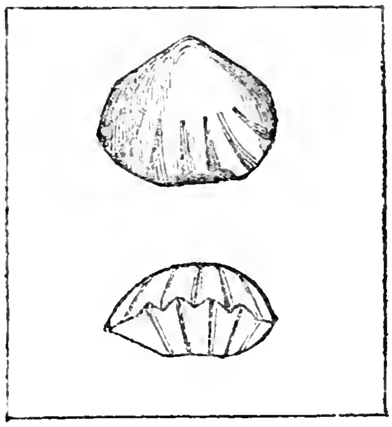


Fig. 21.



Figs. 22 and 23.

Figs. 17, 18, and 19.—*Atrypa plena.*

Figs. 20, 21, 22, and 23.—*Atrypa hemiplicata.*

Atrypa hemiplicata is easily recognised by its smoothness in the upper part, and by the broad folds below, which extend only half way to the beaks. This fossil is somewhat pentagonal, wider than long, and generally rather flat than globose. The sinus as well as the broad plications extend only half the length, and the surface is sometimes marked "by fine, concentric, filiform, subimbricating lines, which are more conspicuous towards the base of the shell, and beautifully undulated in crossing the plications." The beaks are very short, and about equally incurved. It is rather common in the Trenton limestone, but not so abundant as *A. increbescens*. The specific means simply *half-plicated.*

Professor Hall says:—"This peculiar and beautiful species is rarely found in western localities, but is nevertheless extensively distributed in New York. It is readily distinguished by its usually rotund figure, and short prominent plications in the lower half of the shell, while it is smooth above, or only marked by fine concentric lines. The sinus at the base usually occupies one fifth of the circumference of the shell, which, with the basal and cardinal slopes, give it a pentagonal appearance. In many specimens collected from the crystalline limestone, I have been able to observe only the plications on the mesial portion, while in the softer or shaly limestone, the lateral ones have all the distinctness of those presented in the figures."

Palæontology of New York, Vol. 1, Page 144.

ARTICLE XXXIV.—*Natural History of the Wolf, (Canis Lupus,) and its varieties.*

GENUS CANIS, (Linnæus.)

DENTAL FORMULA.—*Incisive*, $\frac{6}{6}$; *Canine*, $\frac{1-1}{1-1}$; *Molar*, $\frac{6-6}{6-6}$.

GENERIC CHARACTERS.—"The three first in the upper jaw, and the four in the lower, trenchant but small, and called also false molars. The great carnivorous tooth above bi-cuspid, with a small tubercle on the inner side, that below with the posterior lobe altogether tubercular, and two tuberculous teeth behind each of the great carnivorous teeth; muzzle, elongate; tongue soft; ears erect, (sometimes pendant in the domestic varieties); fore feet pentadactylous, (five-toed); hind feet tetradactylous, (four-toed); teats both inguinal and ventral." *

CANIS LUPUS, (Linn.) THE AMERICAN WOLF.

There are several varieties of the American Wolf differing so much from each other as to lead naturalists to suspect that they are distinct species, and did not originate from the same primeval stock. They are all about the same size, and band together in the same pack; the Black, White, Grey, and Red being often seen in the same company. The Grey Wolf, the variety most common in Canada, bears a very striking resemblance to the European Wolf. There are, however, differences which appear to be permanent, and which occur in all the varieties of American Wolves; the body is generally more robust; the legs shorter and the muzzle thicker and more obtuse in the latter. Audubon and Backman state that "they have examined a number of European Wolves, and although there were great differences between the various specimens, they were not able to satisfy themselves that the American Wolf is the largest, as supposed by other authors. They regard them as about the same size, and as exhibiting only varieties, not specific differences. The body of the American Grey Wolf is long and gaunt; muzzle elongated, and somewhat thicker than that of the Pyrenean Wolf; head thick; nose long; ears erect and conical; eyes oblique, as is the case in all true wolves—pupil of the eye circular; tail straight, and bushy. The animal does not curl it over the back like a dog.

"Behind the cheek there is a bunch of hairs, which look like a collar. The hairs are of two kinds, the longer coarse and rigid, the under fur soft and woolly; whiskers very few, and coarse and rigid; nails long, slightly arched. The long hairs, from their roots, for one third of their length, are yellowish white, then a broad band of brown follows, succeeded by yellowish brown, and the tips are black. The under fur is ashy brown. On the under surface the long hairs are white, nearly to the roots.

"The general appearance of the upper surface is dark brindled grey, with an indistinct dorsal line a little darker than the colour of the sides.

* **Audubon & Bachman's Quadrupeds of America, vol. 2, page 126.**

The under parts are dull white.

Nostrils black; from the nose towards the eyes, reddish yellow. The outer surface of the ears, and outsides of hind legs. from the hip to the knee joint, are also reddish yellow. The whiskers are black.

DIMENSIONS.

	Feet.	Inches.
Length from point of nose to root of tail............	4	0
Length of tail. (vertebræ)........................	1	1
Length of tail to end of hair......................	1	5
Height of ear....................................	0	4
Breadth of ear...................................	0	3
From nose to end of skull.........................	0	11½
From the eye to point of nose.....................	0	5
Shoulder to longest nail..........................	2	4
Longest upper canine tooth.......................	0	1½

Length of the hair on the back, 3 to 4 inches." *

The above are the dimensions and description of a Grey Wolf, and so far as form and dimensions are concerned, they apply nearly to the other varieties. The wolves of America are classified as follows:—

1. *Canis (lupus,) griseus.*—The Grey Wolf, characters as above.

2. *Canis (lupus,) ater.*—The Black American Wolf, size and shape of grey wolf, but black.

3. *Canis (lupus,) albus.*—The White American Wolf, size and shape of the grey wolf, fur over the whole body of a yellowish white colour, with a slight tinge of grey on the nose.

4. *Canis (lupus,) rufus.*—The Red Texan Wolf, shape of the common grey wolf, but color varied with red and black above, lighter beneath; end of tail black. Most common in Texas.

5. *Canis latrans.*—The Barking or Prarie Wolf, intermediate in size between the grey wolf and the common fox; greyish, varied with black, with a straight bushy tail. Inhabits the western praries.

The last is considered, we believe, decidedly a distinct species, but the other four are thought, to be all only varieties of the same. The genus (*Canis*) is remarkable for the endless differences in size and form of the animals classified within it, as may be witnessed in the domestic species.—(Canis familiaris,) which affords permanent races of every size, from three inches in height and four inches long, to four feet in height and six feet long. Neither does this difference consist in size alone, but in the form and proportion of the parts. There is more difference in form between the head of a bull-dog and a grey-hound, than there is between that of the bull-dog and lion. Yet all the domesticated dogs are at present regarded by many good naturalists as descended from the same stock. The variety of characters among the wild dogs are also great in the same species, but not so great as among those subjected by man.

* **Audubon & Bachman, vol. 2, page 280.**

The following particulars concerning the habits of the Wolf have been kindly noted for us by A. Dickson, Esq., of Kingston, who at one period of his active life was as well known for his love of the chase, as he has since become distinguished for his enthusiasm in the cause of Geology and Natural History generally :—

"The Canadian Wolf is a cruel, savage, cowardly animal, with such a disposition that he will kill a whole flock of sheep merely for the sake of gratifying his thirst for blood, when one or two would have been sufficient for his wants. I have always found them the most cowardly of animals,—when caught in a trap, or wounded by a gun, or when cornered up so that they could not escape, I invariably killed them with a club or tomahawk, and I never met with any resistance. It is true I have seen them show some boldness if a number of them had run down a deer when I attempted to drive them away, yet I have always seen them give way if a shot were fired amongst them. They are frequently killed on the road when unable to get into the deep soft snow from weakness. They sometimes so gorge themselves upon a deer that they are helpless, and can be killed with an axe or club. The wolves are very destructive upon the deer, and hunt them singly or in packs, both in summer and winter. If water be near, the deer when hunted, makes for it, as he has a better chance of escape from being able to swim faster and with more ease than the wolf, as it generally loses some time before it strikes the deer track, where he again takes to the land, as he almost invariably swims either up or down the river instead or crossing direct ; indeed, he will sometimes come on shore on the same side, thereby throwing the wolf off the track ; and, if there happen to be weeds or brush about the bank, the deer will often sink himself so that nothing but part of his head will be above water. The wolf then has its chase for nothing, but in the winter season when the deer goes upon the ice the wolf makes a short chase of it, as the deer slips and falls down every bound he makes upon the glare ice. But if the deer take to a rapid, sufficiently deep to sweep the wolf off his feet, and not so deep but that the deer can stand or walk, the chances then are that a strong buck may kill the wolf by striking him with his fore hoofs. I have lost several good dogs in the same manner. In these cases the deer shows great tact in either striking his enemy, or leaping aside and allowing the wolf to be swept past by the current. In winter when there is not a crust sufficiently strong on the snow to carry the wolf, great numbers perish from hunger ; if it were not for that, they would soon become so numerous that the country would be overcome by them.

"Wolves are often shot, but the most successful way of destroying them is by the trap or poison ; since strychnine has been used, a great many have been destroyed in the settlements where they commit depredations. They have been known to kill weak horned cattle two years old, when not protected by older cattle. They have also been known to kill yearling colts.

"One day in travelling along a path, a fine Indian dog I had with me made a sudden dash to one side after some game, and I sat down to eat something, when all of a sudden my dog upset me, when I recovered my equilibrium my first impulse was to punish the dog, which was still clinging to me in fear. I looked round and beheld a monstrous wolf, within a few feet of me. From these attitudes, I felt convinced the dog had started the wrong game and had caught a tartar, he soon retired, and upon examining the dog his hind parts were covered with saliva from the wolf's mouth. I immediately went on, as it commenced snowing, and followed his track for twelve miles before he left the path. The dog was a brave one, yet I could not keep him from my feet the whole of that distance; many dogs will attack a bear that cannot be got to look at a wolf, although well backed by numbers."

The following is from the English Cyclopædia :—

"Sir John Richardson, in the 'Fauna Boreali-Americana,' observes that the Common Wolves of the Old and New Worlds have been generally supposed to be the same species—the *Canis Lupus* of Linnæus. The American naturalists have indeed, he remarks, described some of the northern kinds of wolf as distinct; but it never seems to have been doubted that a wolf possessing all the characters of the European Wolf exists within the limits of the United States. He then goes on to point out that the wolf to which these characters have been ascribed seemed to be the Large Brown Wolf of Lewis and Clark; and, according to them, it inhabits not only the Atlantic countries, but also the borders of the Pacific and the mountains which approach the Columbia River, between the great falls and rapids, but is not found on the Missouri to the westward of the Platte. Richardson remarks that he had seen none of these Brown Wolves.

"In the "New Description of Virginia,' (1640) wolves are mentioned among the beasts found there; and Lawson notices the Wolf of Carolina, and thus describes him :—"The Wolf of Carolina is the dog of the woods. The Indians had no other curs before the Christians came amongst them. They are made domestic. When wild, they are neither so large nor fierce as the European Wolf. They are not man-slayers, neither is any creature in Carolina unless wounded. They go in great droves in the night to hunt deer, which they do as well as the best pack of hounds; nay, one of these will hunt down a deer. They are often so poor that they can hardly run.—When they catch no prey they go to a swamp, and fill their belly full of mud; if afterwards they chance to get anything of flesh, they will disgorge the mud and eat the other. When they hunt in the night, and there are a great many together, they make the most hideous and frightful noise that ever was heard. The fur makes good mufls. The skin, dressed to a parchment, makes the best drum-heads, and if tanned makes the best sort of shoes for the summer countries."

"Catesby says :—"The wolves in America are like those of Europe in shape and colour, but are somewhat smaller. They are more timorous, and not so voracious as those of Europe. A drove of them will fly from a single man, yet in very severe weather there have been some instances to the contrary. Wolves were domestic with the Indians, who had no other dogs before those of Europe were introduced, since which the breed of wolves and

European dogs are mixed and become prolific. It is remarkable that the European dogs that have no mixture of wolfish blood have an antipathy to those that have, and worry them whenever they meet. The wolf-breed act only defensively, and, with his tail between his legs, endeavours to evade the other's fury. The wolves in Carolina are very numerous, and more destructive than any other animal. They go in droves by night, and hunt deer like hounds, with dismal yelling cries."

"Sir John Richardson gives a minute description of the *Canis Lupus occidentalis*, American Wolf, the Missouri Wolf of Lewis and Clark, and states that he does not mean to assert that the differences existing between it and its European congener are sufficiently permanent to constitute them, in the eye of the naturalist, distinct species. The same kind of differences, he observes may be traced between the foxes and native races of the domestic dog of the New World and those of the Old; the former possessing finer, denser, and longer fur, and broader feet, well calculated for running on the snow. These remarks were elicited by a comparison of living specimens of American and Pyrenean wolves; but he had not an opportunity of ascertaining whether the Lapland and Siberian wolves, inhabiting a similar climate with those of America, had similar peculiarities of form, or whether they differed in physiognomy from the wolf of the south of Europe. He therefore considered it unadvisable to designate the northern wolf of America by a distinct specific appellation, lest he should unnecessarily add to the list of synonyms. The word *occidentalis*, which is affixed to the Linnæan name of *Canis Lupus*, is, he tells us, to be considered as merely marking the geographical position of that peculiar race of Wolf.

"This animal is very common throughout the northern regions of America, but more or less abundant in different districts. "Their footmarks," says Richardson, "may be seen by the side of every stream, and a traveller can rarely pass a night in these wilds without hearing them howling around him. They are very numerous on the sandy plains which, lying to the eastward of the Rocky Mountains, extend from the sources of the Peace and Saskatchewan rivers towards the Missouri. There bands of them hang on the skirts of the buffalo (bison) herds, and prey upon the sick and straggling calves. They do not, under ordinary circumstances, venture to attack the full-grown animal; for the hunters informed me that they often see wolves walking through a herd of bulls without exciting the least alarm; and the marksmen, when they crawl towards a buffalo for the purpose of shooting it, occasionally wear a cap with two ears, in imitation of the head of a wolf, knowing from experience that they will be suffered to approach nearer in that guise. On the Barren-Grounds through which the Coppermine River flows I had more than once an opportunity of seeing a single wolf in close pursuit of a reindeer; and I witnessed a chase on Point Lake when covered with ice, which terminated in a fine buck reindeer being overtaken by a large white wolf, and disabled by a bite in the flank. An Indian, who was concealed on the borders of the lake, ran in and cut the deer's throat with his knife, the wolf at once relinquished his prey and sneaked off. In the chase the poor deer urged its flight by great bounds, which for a time exceeded the speed of the wolf; but it stopped so frequently to gaze on its relentless enemy, that the latter, toiling on at a 'long gallop' with its tongue lolling out of its mouth, gradually came up. After each hasty look the poor deer redoubled its efforts to escape; but, either exhausted by fatigue or enervated by fear, it became, just before it was overtaken, scarcely able to keep its feet."

"The same author observes that the wolves destroy many foxes, which they easily run down if they perceive them on a plain at any distance from their hiding-places; and he relates that in January, 1827, a wolf was seen to catch an Arctic Fox within sight of Fort Franklin, and although immediately pursued by hunters on snow-shoes, it bore off its prey in its mouth without any apparent diminution of its speed. The same wolf, he adds, continued for some days to prowl in the vicinity of the fort, and even stole fish from a sledge which two dogs were accustomed to draw home from the nets without a driver. As this kind of depredation could not be allowed to go on, the wolf was waylaid and killed. It proved to be a female, which accounted for the sledge-dogs not having been molested. He further states that the buffalo-hunters would be unable to preserve the game they kill from the wolves if the latter were not as fearful as they are rapacious. The simple precaution of tying a handherchief to a branch, or of blowing up a bladder and hanging it so as to wave with the wind, is sufficient to keep herds of wolves at a distance. At times, however, he says that they are impelled by hunger to be more venturous, and that they have been known to steal provisions from under a man's head in the night, and to come into a traveller's bivouac and carry off some of his dogs. "During our residence in Cumberland House in 1820," continues Sir John, "a wolf, which had been prowling round the fort, and was wounded by a musket-ball and driven off, returned after it became dark, whilst the blood was still flowing from its wound, and carried off a dog from amongst fifty others, that howled piteously, but had not courage to unite in an attack on their enemy. I was told of a poor Indian woman who was strangled by a wolf, while her husband, who saw the attack, was hastening to her assistance; but this was the only instance of their attacking human life that came to my knowledge. As the winter advances and the snow becomes deep, the wolves, being no longer able to hunt with success, suffer from hunger, and in severe seasons many die. In the spring of 1826 a large gray wolf was driven by hunger to prowl amongst the Indian huts which were erected in the immediate vicinity of Fort Franklin, but not being successful in picking up aught to eat, it was found a few days afterwards lying dead on the snow near the fort. Its extreme emaciation and the emptiness of its intestines showed clearly that it died from inanition."

"We learn from the same excellent authority that the American Wolf burrows, and brings forth its young in earths with several outlets, like those of a fox. Sir John Richardson saw some of their burrows on the plains of the Saskatchewan, and also on the banks of the Coppermine River. The number in a litter he states to vary from four or five to eight or nine. After referring to the instances recorded in the narratives of Captain Parry and Captain Franklin of the association of the female wolves with the domestic dog, he relates that he was informed that the Indians endeavour to improve their sledge-dogs by crossing the breed with wolves, and he adds, that the resemblance between the northern wolves and the domestic dog of the Indians is so great, that the size and strength of the wolf seem to be the only difference. "I have more than once," says he, "mistaken a band of wolves for the dogs of a party of Indians; and the howl of the animals of both species is prolonged so exactly in the same key, that even the practised ear of an Indian fails at times to discriminate them."

"Captain Lyon gives the following account of the Esquimaux wolf trap. It is made of strong slabs of ice, long and narrow, so that a fox can with difficulty turn himself in it, but a wolf must actually remain in the position in which he is taken. The door is a heavy portcullis of ice, sliding in two well-secured grooves of the same substance, and is kept up by a line, which, passing over the top of the trap, is carried through a hole at the furthest extremity; to the end of the line is fastened a small hoop of whalebone, and to this any kind of flesh-bait is attached. From the slab which terminates the trap, a projection of ice, or a peg of wood or bone, points inwards near the bottom, and under this the hoop is lightly hooked; the slightest pull at the bait liberates it, the door falls in an instant, and the wolf is speared where he lies."

Fossil Canidæ.

"The remains of the Dog and Wolf have been found in Great Britain. If there were no historical records to prove that the wolf was once an inhabitant of these islands, its abundant remains would testify to the fact.—They were not present in any considerable number in the Bone-Caves of Kirkdale, which were so diligently examined by Dr. Buckland, but they have been found at Paviland in Glamorganshire, and at Overton near Plymouth. After alluding to the difficulty which was more particularly expressed by Cuvier of distinguishing between the Wolf and the Dog, Professor Owen referring to some specimens from Kent's Hole says:—"The more important points of concordance between the skull from Kent's Hole and those of the existing wolf leave no reasonable ground for doubting their specific identity; and the naturalist who does not admit that the dog and the wolf are of the same species, and who might be disposed to question the reference of the British Fossils described in the present section to the wolf must in that case resort to the hypothesis that there formerly existed in England a wild variety of dog having the low and contracted forehead of the wolf, and which had become extinct before the records of the human race. The conclusion however to which my comparison of the fossil and recent bones of the large *Canidæ* have led me is, that the wolves which our ancestors extirpated were of the same species as those which, at a much more remote period, left their bones in the limestone caverns by the side of the extinct bears and hyænas."

"Recognisable remains of the Dog have however been obtained from Bone-Caves. Dr. Schmerling has described and figured an almost entire skull, two right rami of lower jaws, a humerus, ulna, radius, and some smaller bones, indicating two varieties of the domestic dog, from some Bone-Caves near Liège."

ARTICLE XXXV.—*On the Foxes of British North America.*

GENUS VULPES, (Cuvier.)

DENTAL FORMULA.—*Incisive*, $\frac{6}{6}$; *Canine*, $\frac{1-1}{1-1}$; *Molar*, $\frac{6-6}{7-7}$.—42.

GENERIC CHARACTERS.—Muzzle pointed; pupil of the eyes forming a vertical fissure; upper incisors less curved than in the genus CANIS; tail long, bushy and cylindrical.

The arrangement of the teeth and the general osteological structure of the Wolves, Foxes, Domestic Dogs, and Jackals, are the same, and shew them all to be members of a single natural family, capable nevertheless of being subdivided into several inferior groups or genera. The foxes are distinguished by their lengthened muzzles, round heads, erect and triangular ears, long body, short limbs, and long bushy tail. The pupil of the eye also becomes elongated or linear in the day time, although they are nearly circular during the day. *

Audubon & Bachman remark that the "animals of this genus generally are smaller, and the number of species known greater, than among the wolves; they diffuse a fœtid odour, dig, burrows, and attack none but the weaker quadrupeds, or birds, &c.

"The characters of this genus differ so slightly from those of the genus CANIS, that we are induced to pause before removing it from the subgenus in which it had so long remained. As a general rule, we are obliged to admit that a large fox is a wolf, and a small wolf may be termed a fox. So inconveniently large, however, is the list of species in the old genus CANIS, that it is, we think advisable to separate into distinct groups such species as possess any characters different from the true wolves.

"Foxes, although occasionally seen abroad during the day, are nocturnal in their habits, and their character is marked by timidity, suspicion and cunning. Nearly the whole day is passed by the Fox in concealment, either in his burrow under ground, in the fissures of the rocks, or in the middle of some large hollow tree top, or thick pile of brush-wood, where he is well hidden from any passing enemy.

"During the obscurity of late twilight, or in the darkness of night, he sallies forth in search of food; the acuteness of his organs of sight, of smell, and of hearing, enabling him in the most murky atmosphere to trace and follow the footsteps of small quadrupeds or birds, and pounce upon the hare seated in her form, or the partridge, grouse, or turkey, in their nests.

"Various species of squirrels, field rats and moles, afford him a rich repast. He often causes great devastation in the poultry yard; seizes on the goose whilst grazing along the banks of the stream, or carries off the lamb from the side of its mother.

"The cautious and wary character of the Fox, renders it exceedingly

* **English Encyclopædia of Natural History, vol. 4, page 1234.**

difficult to take him in a trap of any kind." * It is however practicable to take the most wary fox in a steel trap, provided it be carefully concealed."

The period of "gestation continues from 60 to 65 days. The cubs are from 5 to 9 in number, and like young puppies are born with hair, and are blind at birth. They leave their burrows generally when three or four months old, and in all predatory expeditions, each individual goes singly and plunders on his own account and for his own special benefit.

"The generic name is derived from the Latin word *Vulpes*, a Fox.

"There are about twelve well known species belonging to the genus—five of which exist in North America." †

The North American species are the following :—

1. The Red Fox, (*Vulpes fulvus*,) of which the Black Fox, Silver Grey Fox, and Cross Fox, are considered varieties. Common in all the British Territories of North America.

2. The Arctic Fox, (*Vulpes lagopus*,) inhabits the Arctic Regions, Hudson's Bay, Labrador, and Siberia. They do not range so far south as Canada.

3. The Grey Fox, (*Vulpes Virginianus*,) inhabits the Southern States, where it is abundant. It is doubtful whether this fox has ever been seen so far north as Canada.

4. The Swift Fox or Kit Fox, (*Vulpes velox*,) is a small animal similar to the Red Fox, but only one half of the size. Inhabits the prairies east of the Rocky Mountains and the plains of the Columbia River.

5. The Jackall Fox, (*Vulpes Utah*,) is larger than the Red Fox, with a black throat and belly, and greyish brown above. Inhabits the Rocky Mountains, and probably ranges in the British Territories.

Of all these, the Red Fox is the most widely distributed throughout North America, and may therefore be considered as the reigning race among the Foxes of this continent. The following is the systematic description given by the eminent naturalists from whose works we have quoted :—

VULPES FULVUS, (Desm.) THE AMERICAN RED FOX.

SPECIFIC CHARACTERS.—" *Fur reddish or fulvous ; beneath the neck and belly white ; chest grey ; front part of the fore legs and feet, black ; toes fulvous ; tip of the tail, white.*" (*Fulvus*,) *Latin, of a yellow or reddish colour.*

"This animal bears so strong a resemblance to the European Fox, (*Vulpes vulgaris*,) that it was regarded as the same species by early naturalists. No one, however, who will compare specimens from both countries, can have a doubt of their being very distinct. Our Red Fox is a little the largest, its legs are less robust, its nose shorter and more pointed, the eyes nearer together, its feet and toes more thickly clothed with fur, its ears shorter, it has a finer and larger brush, and its fur is much softer, finer, and of a brighter colour.

* Audubon & Bachman, vol. 1, pages 44 and 45.

† Idem, page 45.

"It stands higher on its legs than the Grey Fox, (*V. Virginianus*,) and its muzzle is not so long and acute as in that species. It is formed for lightness and speed, and is more perfect in its proportions than any other species in the genus with which we are acquainted.

"The hair on the whole body is soft, silky, and lustrous; the ears are clothed with short hairs on both surfaces, and the feet and toes are so clothed with hair that the nails are concealed. The body of this species has a strong musky smell, far less disagreeable than that either of the skunk or mink. It becomes less offensive in a state of domestication.

Colour.—"Point of nose, outer extremity of ears, and outer surfaces of legs below the knees, black; forehead, neck, flanks, and back, bright reddish, and a little deeper tint on the back and fore-shoulders; around the nostrils, margins of the upper jaw, and chin, pure white; throat, breast, and a narrow space on the under surface, dingy white; extreme end of brush, slightly tipped with white; inner surface of ears, and base on the outer surface, yellowish. The hair on the body is of two sorts; long hairs interspersed among a dense coat of softer, brighter, and more yellowish fur; on the tail the longer interspersed hairs are more numerous, and many of them are quite black, giving the tail a more dusky appearance than the rest of the body.

"In addition to the distinct varieties of this species, the Black and Cross Fox, we have seen some shades of difference in colour in the red variety. In some, the colours on the back are considerably darker than in others.—We have seen several with the nose and chin nearly black, and in others the white tip at the tail is replaced with black."

Dimensions.

	Feet.	Inches.
From point of nose to root of tail..................	2	6
Tail, (vertebræ)................................	1	1
To end of hair..................................	1	5
Height at shoulders.............................	1	1
Height of ears posteriorly......................	0	2¾

The above description of the Red Fox is taken from Audubon and Bachman's Quadrupeds of North America, vol. 2, page 269, and in their account of the habits of the animal, the authors state that it is seldom or never to be met with south of the States of Kentucky and Tennessee. They frequent the coast of New Jersey in great numbers, where they find an abundance of food among the wild fowl, upon which they spring while they are asleep upon the ponds and creeks near the shore, but more particularly from the numerous wounded fowl which escape from the numerous gunners; also crabs and fish which are thrown up dead by the surf, and rabbits, and wading birds, in the summer.

Its habits in Canada are too well known to need any lengthened description here. It preys upon all the smaller productions of the farm-yard, and bears as bad a character here as its near relation the English Fox, the hero of many a fireside tale, has borne for ages in the olden world. That the Fox is a most accomplished mouser, we know from our own personal observations. A few years ago, in the Township of Gloucester, near Ottawa, we shot a female fox which was at the time running across a meadow near the forest, and at a distance from the farm house. It was sunrise one morning about the middle of the month of May, and we fired at the animal at a long rifle range, more with the thought of frightening than with the hope of killing it. By chance, however, the ball took effect, and the Fox dropped suddenly dead. It had been stricken through the heart. Upon examination we found it to be a female who had spent perhaps the greater portion of the night in collecting food for her young. In her mouth were seven meadow mice and two small shrews, of what species we did not then think of ascertaining. It appears to us that these small quadrupeds must be much more rare in the spring than in the autumn, and that a single fox could collect so many in one excursion is a proof of their excellent capacity for hunting. It is probable that after she had caught one she left it in some safe place while she sought out and captured another, which she deposited along with the first, and then caught others. They were all lying lengthwise across her mouth, their tails and heads projecting more or less from between her lips. Had we known her mission, we certainly would have allowed her to pass without molestation. It is said, however, that both parents hunt for their young, and perhaps therefore the orphan family in this instance was not left totally destitute.

The Red Fox will catch birds, both by lying in wait for them and by trailing them up in the manner of a pointer dog, until watching an opportunity he can pounce or spring upon them. Audubon relates the following of a Grey Fox, and states that the Red Fox will hunt in the same way:—

"On a cold, drizzly, sleety, rainy day, while travelling in Carolina, we observed a Grey Fox in a field of broom-grass, coursing against the wind, and hunting in the manner of a pointer dog. We stopped to witness his manœuvres, suddenly he stood still, and squatted low on his hunches; a moment after he proceeded on once more, but with slow and cautious steps; at times his nose was raised high in the air, moving about from side to side. At length he seemed to be sure of his game, and went straight forward, although very slowly, at times crawling on the earth; he was occasionally hidden by the grass, so that we could not see him very distinctly; however, at length we observed him make a dead halt. There was no twisting or horizontal movement of the tail, like that made by the common house cat when ready to make a spring; but his tail seemed resting on the side, whilst his ears were drawn back and his head raised only a few inches from the earth; he remained in this attitude nearly half a minute, and then made a sudden pounce upon his prey; at the same instant the whirring of the distracted covey was heard, as the affrighted birds took wing; two or three sharp screams succeeded, and the successful prowler immediately passed out of the field with an unfortunate partridge in his mouth, evidently with the intention of seeking a more retired spot to make a dainty meal. We had a gun with us, and he passed within long gun shot of us. But, why wound or destroy him. He has enabled us for the first time to bear witness *that he is not only* *a dog, but a good pointer in the bargain;* he has obeyed an impulse of nature, and obtained a meal in the manner in which it was intended by the wise creator that he should be supplied. He seized only a single bird, whilst man, who would wreak his vengence on this poacher among the game, is not satisfied till he has killed half the covey with the murderous gun, or caught the whole breed in a trap, and wrung off their necks in triumph. Condemn not the Fox too hastily; he has a more strikingly carnivorous tooth than yourself, indicating the kind of food he is required to seek; he takes no wanton pleasure in destroying the bird, he exhibits to his companions no trophies of his skill, and is contented with a meal; whilst you are perhaps not satisfied when your capacious bird bag is filled." *

We have often seen the Red Fox in Canada hunting mice or birds in the fields, and at once recognise the truthfulness of the above picture. We have frequently observed his tail erected perpendicularly at the moment, and during the act of springing on his prey, a habit which gives him a grotesque and somewhat ridiculous appearance.

As to the speed of the Red Fox, it is said that in the open plains in the Western States, thirty gentlemen with one hundred hounds chased one for thirteen hours, when the horses and the whole pack of hounds were broken down, and the chase abandoned. These Foxes do not run so swiftly in Canada, and Sir John Richardson says they do not possess the wind of the English Fox. "It runs, says Sir John, for about a hundred yards with great swiftness, but its strength is exhausted in the first burst, and it is soon overtaken by a wolf or a mounted horseman. It may be that the animals of this species inhabiting the prairies or open forests of the West, are more accustomed to long flights, and therefore by natural habit better coursers than those of the densely wooded regions.

The Red Fox digs an extensive burrow in a sandy or gravelly bank, and provides it with a number of entrances, opening out to the surface in different directions. To this retreat he flies when pursued, and when the underground galleries are near the surface may be dug out, the sportsman first stopping up all the openings to prevent his escape.

The young are from four to six at a birth, and are brought forth in the early part of the spring.

The geographical distribution of the animal appears to be from the Hudson's Bay Territories lying north of Canada, south to Kentucky, and in a westerly direction from Labrador, across the continent to the Russian settlements.

* Audubon & Bachman, vol. 1, page 165.

VULPES FULVUS, (*Var Argentatus,*) THE SILVERY GREY OR BLACK FOX.

CHARACTERS.—*Size of the Red Fox; body, silvery black; tip of tail, white; (Argentatus,) Latin, silvery.*

The Silver Grey or Black Fox is considered a variety of the Red Fox, and is chiefly distinguished by his colour and the remarkable richness and beauty of his fur. The following is a full description of a specimen from the Hudson's Bay Territories:—

"Body clothed with two kinds of hair; the longest or outer hair extends in some parts two inches beyond the under or shorter fur, especially on the neck, beneath the throat, behind the shoulders, along the flanks, and on the tail; this hair is soft, glossy, and finer than even that of the pine marten.

"The under fur is unusually long and dense, measuring in some places two inches, and is exceedingly fine, feeling to the hand as soft as the finest sea-island cotton; this under fur surrounds the whole body, even to the tail, on which it is a little coarser, and has more the appearance of wool; it is shortest on the legs and forehead, and least dense on the belly; the hairs composing this fur, when viewed separately, exhibit a crimped or wavy appearance; on the ears and nose scarcely any long hairs are to be seen, these parts being thickly clothed with fur.

"The soles of the feet are so thickly clothed with fur, that no callous spots are visible.

"The under colour is uniformly, blackish, brown, or chocolate; the long hairs are brown at their roots, then silver grey, and are broadly tipped with black; the hairs on the neck, and on the dorsal line extending to the root of the tail, are black, forming a broad black line at the neck, which narrows towards the tail.

"Chin, throat, and whole under surface, brownish black; a tuft of white hairs on the neck, near the chest; another white tuft near the umbilicus; upper parts, glossy, silvery, black; sides sprinkled with many shining white hairs, which produce a somewhat hoary appearance; tail brownish black, to rear the extremity, where it is broadly tipped with white.

DIMENSIONS.

	Feet.	Inches.
Nose to root of tail	2	5
Length of tail	1	7
Height of ear	0	2¾
From nose to end of ear stretched back	0	8½
From nose to eyes	0	3⅓

The rich and beautiful fur of the Silver Grey Fox is not used in this country. Only the luxurious nobles of Russia and other parts of Europe indulging in material so costly. A single skin of the first quality is here £25, and when it reaches its final destination in the markets of the Eastern world is perhaps sold for from 50 to 100 guineas. It is by no means abundant. Sir John Richardson states that upon an average, only four or five of these skins are procured in a season at any one of the posts in the fur countries.

This Fox presents considerable variations, both in size and colour.—Some of them are brilliant black, with the exception of the end of the tail, which is invariably white. Other specimens are bluish grey, and many are tinged with a cinerous colour on the sides; it perhaps is most commonly obtained, with parts of its fur hoary; the shiny black coat being thickly interspersed with white or silvery blue tipped hairs.

Three years since, in the spring of 1853, Mr. Clarke, of the Township of Osgoode, near the City of Ottawa, discovered a burrow of Silver Grey Foxes in that Township, and succeeded in capturing two of the young ones. His dog caught one of the old ones, and Mr. Clarke endeavoured to secure it, but it bit him so severely that he was obliged to let it escape. One of the young animals was intensely black over every portion of his body, except the point of his tail, in which there were a few white hairs only. The other was a beautiful silver grey. This fact proves that the Silver Grey Fox and the Black Fox are only varieties of the same species, since both, in this well authenticated instance, were the progeny of the same parents and at the same birth. These two animals were exhibited with some other animals by the members of the Mechanics Institute and Athenæum, at their exhibition on the occasion of the visit of Lord Elgin in 1853. They were afterwards purchased by Mr. J. Dennison, Fur Dealer in Ottawa, for £15. The Silver Grey hung himself with his chain, and the Black one, owing to his having on more than one occasion nearly succeeded in making his escape, was killed. Mr. Dennison informs us that he afterwards sold the two skins for £30. He is a fortunate trapper who can display among the contents of his pack a couple of good Silver Grey Foxes.

This Fox is chiefly found in the colder portions of the British Territories. They are only rarely to be met with south of the St. Lawrence.

The Grey Fox of the Southern States (Vulpes Virginianus,) in a very different animal, and its fur is not so valuable. There is no fur produced in North America so precious as that of the Silver Grey Fox. The habits of the animal appears to be in no respect different from those of the Common Red Fox.

VULPES FULVUS, (*var. decussatus,*) THE CROSS FOX.

CHARACTERS.—*A cross on the neck and shoulders, and a longitudinal stripe on the under surface black; (Decussatus,) Latin, crossed.*

Sir John Richardson, and in fact most naturalists, hunters, and Indians, regard the Cross Fox as a mere variety of the Red Fox. He says I found on inquiry that the gradations of colour between characteristic specimens of the Cross and Red Fox, are so small that the hunters are often in doubt with respect to the proper denomination of the skin; and I was frequently told, "this is not a cross Fox yet, but becoming so." It is worthy of remark, moreover that the European Fox (*Vulpes vulgaris,*) is subject to similar varieties, and that the *Canis crucigera* of Gesner, differs from the latter animal in the same way that the American Cross Fox does from the Red one.

The Cross Fox is frequently taken in Canada, and differs only from the true Red Fox in the fur being of a finer quality, and the presence of a cross upon the shoulders. The following is a full description :—

" Form agrees in every particular with that of the Common Red Fox ; fur rather thick and long, but not thicker or more elongated than in many specimens of the Red Fox that we have examined ; soles of the feet densely clothed with short woolly hairs, so that the callous spots at the roots of the nails are scarcely visible ; a black longitudinal stripe more or less distinct on the under surface.

Colour.—" Front of the head and back, dark grey ; the hairs being black at the roots, yellowish white near the ends, and but slightly tipped with black, so that the light colour of the under part of each hair showing through gives the surface a grey tint, with these hairs a few others are mixed that are black throughout their whole length.

" The soft fur beneath these long hairs is of a brownish black ; inner surface of ears and sides of the neck from the chin to the shoulders, pale reddish yellow ; sides behind the shoulders towards the top of the back, slightly ferruginous ; fur underneath the long hair, yellowish ; tail, dark brown ; fur beneath, the long hairs yellowish at base, broadly tipped with black ; a line along the under surface for half its length, and broadest at its termination, black ; a few white hairs intermixed, but not a sufficient number to alter the general colours. The yellowish tint on each side of the neck and behind the shoulders *is divided by a longitudinal dark brown band on the back, crossed at right angles by another running over the shoulders and extending over the fore legs, forming a cross.* There is another cross yet more distinctly marked upon the chest ; a black stripe, extending downward from the throat toward the belly, being intersected by another black line which reaches over the chest from the inside of one fore-leg to the other.—Hence the name of this animal does not originate in its ill nature, or by reason of its having any peculiarly savage propensity, as might be presumed, but from the singular markings we have just described." *

The habits of this animal are the same as those of the Red Fox. It is not so common, and its skin is worth in the market about three times as much.

The three foxes described in the preceding pages are all that inhabit the Canadas, but farther north we have another and very distinct species within the British Territories.

* Audubon & Bachman, vol. 1, page 46.

VULPES LAGOPUS, THE ARCTIC FOX.

SPECIFIC CHARACTERS.—*Ears rounded, short, and folded at the edges; cheeks with a ruff; colour in summer, brown; in winter, white. Specific name from the Greek, (Lagos,) a hare, and (pous) the foot, literally the hare-footed Fox.*

The head of this Fox is not so much pointed as in other species of Fox, and the ears present the appearance of having been cropped.

"The cheeks are ornamented by a projecting ruff, which extends from behind the ears quite round the lower part of the face, to which it gives a pleasing appearance. The legs are long, the soles of the feet are covered with dense woolly hair, and the claws are long and strong.

"In winter this animal is white, but in summer it becomes brown, the change taking place in May. It is well adapted to endure the severest cold, and the provision which nature has made of a hairy covering, for the soles of its feet enables it to run upon the glare ice without slipping, or upon the snow without sinking into it."

The following description of its habits is given by Audubon and Bachman:—

"The Arctic Fox is a singular animal, presenting rather the appearance of a little stumpy, round-eared cur, than that of the sharp and cunning-looking Foxes of other species which are found in more temperate climes. The character (for all animals have a character) and habits of this species are in accordance with its appearance; it is comparatively unsuspicious and gentle, and is less snappish and spiteful, even when first captured, than any other Fox with which we are acquainted.

"At times there is seen a variety of this Fox, which has been called the Sooty Fox, but which is in all probability only the young, or at any rate is not a permanent variety, and which does not turn white in winter, although the species generally becomes white at that season. It is said likewise that the white Arctic Foxes do not assume a brown tint in the summer.—Richardson says that only a majority of these animals acquire the pure white dress even in winter; many have a little duskiness on the nose, and others, probably young individuals, remain more or less coloured on the body all the year. On the other hand, a pure white Arctic Fox is occasionally met with in the middle of summer, and forms the variety named *Kakkortak* by the Greenlanders.

"Mr. William Morton, ship's steward of the Advance, one of Mr. Henry Grinnell's vessels sent in search of Sir John Franklin and his party, although not a naturalist, has furnished us with some account of this species. He informs us that while the vessels (the Advance and Rescue) were in the ice, the men caught a good many Arctic Foxes in traps made of old empty barrels on the ice; they caught the same individuals in the same trap several times, their hunger or their want of caution leading them again into the barrel when only a short time released from captivity.

"They were kept on board the vessels for some days, and afterwards let loose; they did not always appear very anxious to make their escape from the ships, and those that had not been caught sometimes approached vessels on the ice, where, first one would appear, and after a while another, showing that several were in the neighbourhood. They were occasionally observed on the rocks and snow on the land, but were not seen in packs like wolves; they do not take to the water or attempt to swim.

"These Foxes when they see a man do not appear to be frightened; they run a little way, and then sit down on their haunches like a dog, and face the enemy before running off entirely. They are said to be good eating, the crews of the vessels having feasted on them, and are fat all the winter.—They were occasionally seen following the polar bear to feed on his leavings, seals, flesh of any kind, or fish.

"Those they captured were easily tamed, seldom attempting to bite even when first caught, and by wrapping a cloth around the hand some of them could be taken out of the barrel and held, not offering more resistance than a snap at the cloth.

"Several beautiful skins of this animal were brought home by Dr. E. K. Kane, the accomplished surgeon of the expedition, and have since been presented by him to the Academy of Natural Sciences at Philadelphia.

"Captain Lyon, during two winters passed on the Melville peninsula, studied with attention the manners of several of these animals. He says:—"The Arctic Fox is an extremely cleanly animal, being very careful not to soil those places where he eats or sleeps. No unpleasant smell is to be perceived even in a male, which is a remarkable circumstance. To come unawares on one of those creatures is, in my opinion, impossible, for even when in an apparently sound sleep they open their eyes at the slightest noise which is made near them, although they pay no attention to sounds when at a short distance. The general time of rest is during the daylight, in which they appear listless and inactive; but the night no sooner sets in than all their faculties are awakened; they commence their gambols, and continue in unceasing and rapid motion until the morning. While hunting for food, they are mute, but when in captivity or irritated, they utter a short growl like that of a young puppy. It is a singular fact, that their bark is so undulated as to give an idea that the animal is at a distance, although at the very moment he lies at your feet.

"Although the rage of a newly caught Fox is quite ungovernable, yet it very rarely happened that on two being put together they quarrelled. A confinement of a few hours often sufficed to quiet these creatures; and some instances occurred of their being perfectly tame, although timid, from the first moment of their captivity. On the other hand, there were some which, after months of coaxing, never became more tractable. These we suppose were old ones.

"Their first impulse on receiving food is to hide it as soon as possible, even though suffering from hunger, and having no fellow-prisoners of whose honesty they are doubtful. In this case snow is of great assistance, as being easily piled over their stores, and then forcibly pressed down by the nose. I frequently observed my Dog-Fox, when no snow was attainable, gather his chain into his mouth, and in that manner carefully coil it so as to hide the meat. On moving away, satisfied with his operations, he of course had drawn it after him again, and sometimes with great patience repeated his labours five or six times, until in a passion he has been constrained to eat his food without its having been rendered luscious by previous concealment. Snow is the substitute for water to these creatures, and on a large lump being given to them they break it in pieces with their feet and roll on it with great delight. When the snow was slightly scattered on the decks, they did not lick it up as dogs are accustomed to do, but by repeatedly pressing with their nose collected small lumps at its extremity, and then drew it into the mouth with the assistance of the tongue."

"In another passage, Captain Lyon, alluding to the above-named Dog-Fox, says:—"He was small and not perfectly white; but his tameness was so remarkable that I could not bear to kill him, but confined him on deck in a small hutch, with a scope of chain. The little animal astonished us very much by his extraordinary sagacity, for during the first day, finding himself much tormented by being drawn out repeatedly by his chain, he at length, whenever he retreated to his hut, took this carefully up in his mouth, and drew it so completely after him that no one who valued his fingers would endeavour to take hold of the end attached to the staple."

"Richardson says that notwithstanding the degree of intelligence which the anecdotes related by Captain Lyon shew them to possess, they are unlike the Red Fox in being extremely unsuspicious; and instances are related of their standing by, while the hunter is preparing the trap, and running headlong into it the moment he retires a few paces. Captain Lyon received fifteen from a single trap in four hours. The voice of the Arctic Fox is a kind of yelp, and when a man approaches their breeding places they put their heads out of their burrows and bark at him, allowing him to come so near that they may easily be shot.

"They appear to have the power of decoying other animals within their reach, by imitating their voices. "While tenting, we observed a Fox prowling on a hill side, and heard him for several hours afterwards in different places, imitating the cry of a brentgoose." They feed on eggs, young birds, blubber, and carrion of any kind; but their principal food seems to be lemmings of different species.

"Richardson thinks the "brown variety," as he calls it, the more common one in the neighbourhood of Behring's Straits. He states that they breed on the sea coast, and chiefly within the Arctic circle, forming burrows in sandy spots, not solitary like the Red Fox, but in little villages, twenty or thirty burrows being constructed adjoining to each other. He saw one of these villages on Point Turnagain, in latitude 68½°. Towards the middle of winter, continues our author, they retire to the southward, evidently in search of food, keeping as much as possible on the coast, and going much farther to the southward in districts where the coast line is in the direction of their march. Captain Parry relates that the Arctic Foxes, which were previously numerous, began to retire from Melville peninsula in November, and that by January few remained. "Towards the centre of the continent, in latitude 65°, they are seen only in the winter, and then not in numbers; they are very scarce in latitude 61°, and at Carleton House, in latitude 53°, only two were seen in forty years. On the coast of Hudson's Bay, however, according to Hearne, they arrive at Churchill, in latitude 59°, about the middle of October, and afterwards receive reinforcements from the northward, until their numbers almost exceed credibility. Many are captured there by the hunters, and the greater part of the survivors cross the Churchill river as soon as it is frozen over, and continue their journey along the coast to Nelson and Severn rivers. In like manner they extend their migrations along the whole Labrador coast to the gulf of St. Lawrence. Most of those which travel far to the southward are destroyed by rapacious animals; and the few which survive to the spring breed in their new quarters, instead of returning to the north. The colonies they found are however soon extirpated by their numerous enemies. A few breed at Churchill, and some young ones are occasionally seen in the vicinity of York factory. There are from three to five young ones in a litter."

"The trap in which the Arctic Fox is taken by the Esquimaux, is described by authors as simple: it consists of a little hut built of stone, with a square opening on the top, over which some blades of whalebone are extended nearly across, so as to form an apparently secure footing, although only fastened at one end, so that when the animal comes on to them to get the bait, they bend downward and the Fox is precipitated into the hut below, which is deep enough to prevent his jumping out, the more especially because the whalebone immediately rises again to its position, and the bait being fastened thereto, several Foxes may be taken successively. Other traps are arranged so that a flat stone falls on the Fox when he, by pulling at the bait, disengages the trigger. These Foxes are also caught in traps made of ice (in which wolves are taken at times by the Esquimaux). These traps are thus described by Dr. Richardson, and are certainly composed of the last material we, dwellers in more favoured lands, would think of for the purpose: "The Esquimaux wolf-trap is made of strong slabs of ice, long and narrow, so that a Fox can with difficulty turn himself in it, but a wolf must actually remain in the position in which he is taken. The door is a heavy portcullis of ice, sliding in two well-secured grooves of the same substance, and is kept up by a line, which, passing over the top of the trap, is carried through a hole at the farthest extremity; to the end of the line is fastened a small hoop of whalebone, and to this any kind of flesh-bait is attached. From the slab which terminates the trap, a projection of ice or a peg of wood or bone points inwards near the bottom, and under this the hoop is slightly hooked; the slightest pull at the bait liberates it, the door falls in an instant, and the wolf (or Fox) is speared where he lies."

"In speaking of the *Sooty Fox*, which is only a variety of the present species, Dr. Richardson says: "On one occasion during our late coasting voyage round the northern extremity of America, after cooking our supper on a sandy beach, we had retired to repose in the boats, anchored near the shore, when two Sooty Foxes came to the spot where the fire had been made, and carrying off all the scraps of meat that were left there, buried them in the sand above high water mark. We observed that they hid every piece in a separate place, and that they carried the largest pieces farthest off."

GEOGRAPHICAL DISTRIBUTION.

" Arctic Foxes have been seen as far north on the American continent as man has ever proceeded. They are numerous on the shores of Hudson's Bay, north of Churchill, and exist also in Bhering's straits; towards the centre of the continent in latitude 65°, they are seen only in the winter, and then not in numbers. They are very scarce in latitude 61°, and at Carlton House in latitude 53°, only two were seen in forty years. On the coast of Hudson's Bay, however, according to Hearne, they arrive at Churchill in latitude 59°, about the middle of October, and afterwards receive reinforcements from the northward. On the eastern coast of America they are found at Labrador, where they have been seen occasionally in considerable numbers: a few have been also observed in the northern parts of Newfoundland, about latitude 52°.

" On the eastern continent they are found in Siberia, and in all the Arctic regions."

ARTICLE XXXVI.—*On the Canadian Otter, (Lutra Canadensis.)*

GENUS LUTRA, (Ray.)

DENTAL FORMULA.—*Incisive*, $\frac{6}{6}$; *Canine*, $\frac{1}{1}$–$\frac{1}{1}$; *Molar*, $\frac{5}{5}$–$\frac{5}{5}$.—36.

GENERIC CHARACTERS.—" The second inferior incisors on each side a little receding in most of the species; the canine much dilated, hooked; first superior molar, small, blunt, and sometimes deciduous; the second, cutting; the third of similar form, but larger; the fourth with two external points, but furnished with a strong spur on the inner side; the fifth has externally three small points, with a broad spur internally. The inferior molars in this genus vary from five to six, the first being wanting in some of the species.

" Head, large and flattish, terminating in a blunt muzzle; ears, short and round; tongue, slightly papilous; body, long and slender; legs, short; toes, five on each foot. In some of the species the fifth toe on the hind foot is rudimental; toes webbed, armed with short claws, which are not retractile; tail not so long as the body, thick and flattened horizontally.

" Body covered externally with long rigid and glossy hair, with a softer, shorter, downy fur intermixed.

" On each side of the anus there is a small gland secreting fetid matter.

" All the species are good swimmers, live along the banks of the rivers and ponds, and feed on fish.

" The generic appellation is derived from Lutra, an Otter; from the Greek, *Louo*, to wash.

"There are eleven species enumerated by authors, inhabiting the following countries ;—Europe, 1 ; Island of Trinidad, 1 ; Guyana, 1 ; Brazil, 1 ; Kamschatka, 1 ; Java, 1 ; Malay, 1 ; Pondicherry, 1 ; The Cape of Good Hope, 1 ; and North America, 2. *

LUTRA CANADENSIS (SABINE), THE CANADA OTTER.

SPECIFIC CHARACTERS.—*Dark glossy brown ; chin and throat, dusky white ; larger than the Evropean Otter.*

The Canadian Otter inhabits the whole of North America, and it is supposed a portion of South America also. Specimens procured from the Southern countries of the continent, such as Texas and Carolina, can scarcely be distinguished from those brought from the extreme North, the fur being of nearly the same quality, and the colour being only a little lighter in those from the warm climates. Throughout the whole of this vast territory, the animal is found in the rivers and lakes of every district, except indeed where extirpated by man in the most densely populated tracts of country.

The head of the Otter is large, and nearly of a globular form ; the nose blunt and naked ; the lips thick ; ears rounded, slightly ovate, and closer together than in the Otter of Europe, (*Lutra vulgaris,*) and clothed densely with short hair on both surfaces. The body is long and cylindrical ; the neck long ; the legs short and stout ; moustaches very rigid, like bristles ; soles of the feet thinly clothed with hair ; between the toes, tubercles at the roots of the claws, naked ; feet webbed to the nails ; tail stout, gradually tapering toward the extremity, depressed at the base, continuing flattened through half its length ; at the base there are two oval glands. The longer hairs covering the fur are glossy and rigid ; fur soft, dense, and nearly as fine as that of the Beaver, continuing through the whole extent of the body, even to the extremity of the tail, but shorter on the forehead and extremities. The general colour of the animal is a rich chesnut brown, a shade lighter on the whole of the under surface.

This animal brings forth one litter annually, about the middle of April, in the northern countries, and about a month earlier in the southern. Its nest is constructed either in a hole in a bank near the water or in the hollow of a large tree. These nests are large—composed of small sticks, leaves, and soft grass, and are in all cases above the reach of high water, and made comfortable by being well protected and sheltered from the rains.

The Otter is a famous swimmer and diver, and can easily capture almost any kind of fish. Audubon states that in one locality, near Charleston, in the Southern States, where they were very nemerous about thirty years since, he went one morning to observe them, and in the space of two hours counted forty-six. They came down with the receding tide in groups, or families of five or six together, and ascended the different creeks in the salt marshes and engaged in capturing mullets. In most cases they came to the bank with a fish in their mouth, despatching it in a minute, and then again hastened in after more prey. As the tide rose, they returned up the river again to their more secure retreats.

*** Audubon & Bachman, vol. 2, page 1.**

Our friend A. Dickson, Esq., who has studied their habits and kept them in confinement in Canada, has furnished us with the following accounts :—

"The Otter lives principally on fish, but will eat any kind of flesh readily. It is surprising to see the quantity of fish it will consume during the twenty-four hours; night and day it is on the move, either in search of food or play.

"The habits of the Otter differ much from those of the Beaver, who has a local habitation. The Otter, on the contrary, is always on the march from one lake or pond to another, yet it regularly visits particular places in its rounds, where it has what is called a slide, on the bank of a lake or river, where it rolls or draws itself along with its belly on the ground. Near these places it has its hole in the bank. It may appear strange, yet I have known an Otter bring forth her young in the hollow of a fallen tree a mile from any water.

"The Otter is hunted for the value of its skin, its flesh being very rank and unpalatable: yet Indians and hunters are often glad to partake of it when other food is scarce.

"The Otter is generally killed by trapping, sometimes in the water, other times on land, on their slides, covering the trap with leaves, and when caught by the fore foot, does not leave his foot in the trap and escape like the Beaver and Musk-rat. It is often shot by the hunter in his wanderings, and occasionally it is killed when travelling through the wood if the hunter meets it, especially if he has a good dog. If the Otter make his escape to a pond or lake when pursued, ten chances to one he will immediately leave it on the opposite side and make his way to some other lake. If the dog has been in the habit of hunting the Otter, he will follow round the lake until he gets on the trail. I have known an Otter to pass five small lakes and then take refuge in a hollow tree, where he was killed. It requires a very good dog to master an Otter, as they have sharper teeth than any quadruped in Canada, and their thick loose skin protects them.

"The Otter is a playful and affectionate pet when taken young. I had one as much domesticated as a dog,—it would follow me all over the farm or village, but he preferred a stroll along the bank of the river, or an excursion in a canoe; occasionally he would catch a fish, but the number of bullfrogs he would kill was astonishing. I never saw him eat any, but he appeared to be pleased with the sport of catching them and letting them go the moment he got his eye on a fresh one. In one of those excursions he appeared to be in trouble, and made a great noise; I went back to see what was the matter and found he had got an over-grown mud-turtle among the weeds on the shore, he appeared pleased when I went to his assistance, as he could do nothing with his game. I do not think an Otter is able to kill a large turtle; yet, I found he relished eating it after it was cut up with the axe.

"When I took the fishing rod into my hand, he went into extacies. I never saw a dog fonder of a gun than he was of the fishing rod. He would go perhaps a dozen times a day fishing on his own account, always accompanied by a young collie dog, which stood on the top of the boom, watching every movement of his friend among the finny tribe; before the Otter made a den for himself, the dog and he used to sleep huddled up together as if they belonged to the same litter.

"I frequently used to cut up a fish into small pieces and throw it off the bridge; before it reached the water the Otter was on its way towards it as straight as a line, but before he could reach the desired object a number of chub would be contending with eagerness for it. Nekeek soon put an end to the dispute by grabbing the first he could catch; if the chub escaped, he always seized the piece of fish that was thrown in. In such cases he immediately swam under water, sometimes on his back and sometimes on his feet, but always came on shore to eat his food; when doing so, he held his head up and shut his eyes, which easily accounts for the success I had in shooting them when eating. When done fishing he was sure to rub himself upon the carpet if he could get into the house, when he failed in that, he would rub himself against some friend's legs, or on any of the dogs belonging to the place if he could catch them asleep. Nekeek was like many in the world, he had his friends and his enemies; when he was young he was fed on cow's milk, and was often favoured with it from the teat; it was surprising to see how he could catch it in his mouth; but one cow not relishing such practices, upset both milker and pail, and almost killed his Ottership: after some time he recovered, but never forgot the injury, indeed the feeling appeared to be reciprocal whenever they met, both gave signs of displeasure.

"He commenced to dig a hole in the garden and formed comfortable lodgings under the platform at the door, where he spent his nights on a bed of straw which he carried in.

"Like all other animated things, Nekeek had an end, and like many human beings, he perished in the fluid in which he took greatest delight.—He had some friends about the mills who used to give him an eel for his breakfast, hence he spent a part of his time there, and by some means got into a reaction wheel where he was drowned. Perhaps if the favourite horse or cow had died, there would not have been as much lamentation as there was for poor Nekeek for weeks afterwards. Collie would be seen for hours on the boom looking for his friend."

The capability of the Otter for domestication, is not confined to the American species. "Goldsmith mentions an Otter which went into a gentleman's pond at the word of command, drove the fish up into a corner, and having seized on the largest, brought it out of the water to its master. Daniel, Bewick, and Shaw, record instances of the animal's docility in this way. Mr. Bell and Mr. McGillivray both corroborate the fact. The latter has collected the following anecdotes:—Mr. McDiarmid, in his amusing "Sketches from Nature," gives an account of several domesticated Otters, one of which, belonging to a poor widow, when led forth plunged into the Urr or the neighbouring burns and brought out all the fish it could find.—

Another, kept at Crosbie House, Wigtonshire, evinced a great fondness for gooseberries, fondled about her keeper's feet like a pup or kitten, and even seemed inclined to salute her cheek when permitted to carry her freedom so far. A third belonging to Mr. Monteith, of Carstairs, was also very tame, and though he frequently stole away at night to fish by the pale light of the moon and associate with his kindred by the river side ; his master was, of course, too generous to find any fault with his peculiar mode of spending his evening hours. In the morning he was always at his post in the kennel, and no animal understood better the secret of keeping his own side of the house. Indeed his pugnacity in this respect gave him a great life in the favour of the gamekeeper, who talked of his feats wherever he went, and avowed besides, that if the best cur that ever ran 'only daured to grin' at his protege, he would soon 'mak his teeth meet through him.' To mankind, however, he was much more civil, and allowed himself to be gently lifted by the tail, though he objected to any interference with his snout, which is probably with him the seat of honour." *

Audubon on two occasions domesticated the Canada Otter. He states "The individuals had been captured quite young, and in the space of two or three days became as tame and gentle as the young of the domestic dog.—They preferred milk and boiled corn meal, and refused to eat fish or meat of any kind until they were several months old. They became so attached to us, that at the moment of their entrance into our study they commenced crawling into our lap—mounting our table, romping among the books and writing materials, and not unfrequently upsetting our inkstand, and disarranging the papers."

He has also seen them amusing themselves at their slides, and says, "The Otters ascend the bank at a place suitable for their diversion, and sometimes where it is very steep, so that they are obliged to make quite an effort to gain the top ; they slide down in rapid succession where there are many at a sliding place. On one occasion we were resting ourselves on the bank of Canoe Creek, a small stream near Henderson, which empties into the Ohio, when a pair of Otters made their appearance, and not observing our proximity, began to enjoy their sliding pastime. They glide down the soap-like muddy surface of the slide with the rapidity of an arrow from a bow, and we counted each one making twenty-two slides before we disturbed their sportive occupation." This habit of the Otter of sliding down from elevated places to the borders of streams is not confined to cold countries, or to slides on the snow or ice, but is pursued in the Southern States where the earth is seldom covered with snow, or the waters frozen over. Along the reserve dams of the rice fields of Carolina and Georgia, these slides are very common. *

The fur of the Otter is highly esteemed by manufacturers, and a good skin is worth from six to ten dollars, according to size and fluctuation of the market.

* English Encyclopædia, vol. 3, page 554.
* Audubon & Bachman, vol. 2, page 8.

ARTICLE XXXVII.—*On the Bob-link or Rice-Bird, (Dolichonyx orzivora.)*

At the present season of the year almost every meadow in the country possesses one or more families of Bob-links, birds not only remarkable for the richness of their music, but also for the changes of their plumage and the extent of their migrations. The female of this species much resembles a small blackbird in form, but her colour is yellowish-brown, with blackish streaks running from the head in the direction of the tail. The male during the spring and summer is easily distinguished by a large cream-coloured or whitish patch upon the back of his neck. He has also a white spot on each wing, and his back is yellow. They inhabit and breed in the meadows, never in the woods. A couple of hours walk into the country will be well repaid by hearing the extraordinary song of this bird, and witnessing the amusing pomposity of his motions.

These birds arrive in Canada in the month of May, and immediately settle themselves in the meadows, where the female commences preparations for rearing her young, while the male cheers her with his music. The nest is constructed on the ground, composed of leaves and coarse grass, and lined on the inside with the same materials, but of a finer quality. The eggs are five, of a bluish white, and the young when brought forth are of the colour of the female.

" The song of the male, while the female is sitting, is singular and very agreeable. Mounting and hovering on wing at a small height above the field, he chaunts out such a jingling melody of short, variable notes, uttered with such seeming confusion and rapidity, and continued for a considerable time, that it appears as if half a dozen birds of different kinds were singing together. Some idea may be formed of this song by striking the high keys of a pianoforte at random, singly and quickly, making as many sudden contrasts of high and low notes as possible. Many of the tones are in themselves charming, but they succeed each other so rapidly that the ear can hardly separate them. Nevertheless the general effect is good, and when ten or twelve are all singing on the same tree, the concert is extremely pleasing." *

When there are a number breeding in the same field, often a small flock of the males may be heard at once from the same tree, commencing one after another, and sometimes ceasing all at the same time. The rich jangle of notes poured forth by a large party is extremely interesting. The song consists of a rapid rigmorole of notes somewhat like *kukle-eye-ko wukle-any-kang kang kukle-ee-ke kilik kilik-ilik-ang kang*, &c., uttered with great rapidity, and the sounds running into each other towards the conclusion. It is to be observed that the bird, on some occasions, commences this song several times before he gets through with it, as if he were endeavouring to recollect it.

* Wilson's Ornithology.

The migrations and changes of plumage of this little bird are exceedingly curious. During the breeding season, May, June, and July, they seem to spread over all the middle portion of the continent, as far north as the 54th degree of north latitude. In July the male begins gradually to lose his remarkable dress, and to assume that of the female. In August the sexes cannot be distinguished from each other, except by dissection. Males, females, and the young of that season, then all wear the same homely garb. The male has also lost his song. They have but one brood in the season, and during the early portion of the autumn, innumerable families congregate into prodigious swarms and pour down upon the southern countries. In Canada they are sometimes called during their autumnal flight "little brown blackbirds," and occasionally they commit great depredations upon the fields of oats. Few persons then suspect that they and the Bob-links are the same birds, as their dress and habits are different, and the only note they utter is a short and sharp "klink." The Bob-link of the summer is an inoffensive and highly amusing fellow, delighting all observers with his song, and feeding only upon insects and their larvæ; but he of the autumn is a ruthless and hated depredator, devastating whole fields of grain. Their ravages in the South are of a much more formidable character than they are in the British Provinces. Wilson says "They collect in great multitudes, and pour down upon the oat-fields of New England like a torrent, depriving the proprietors of a good part of their harvest; but, in return, often supply his table with a very delicious dish. From all parts of the North and Western regions, they direct their course towards the South, and about the middle of August revisit Pennsylvania, on their route to winter quarters. For several days they seem to confine themselves to the fields and uplands; but as soon as the seeds of the reed are ripe, they resort to the shores of the Delaware and Schuylkill in multitudes; and these places during the remainder of their stay appear to be their grand rendezvous. The reeds or wild oats, furnish them with such abundance of nutritious food, that in a short time they become extremely fat, and are supposed by some of our epicures to be equal to the famous ortolans of Europe. Their note at this season is a single *chink*, and is heard overhead with little intermission from morning to night." On their first arrival in the Southern States from the North in the autumn they are lean, but in a few days they become so fat that each bird is said to be nothing more than a compact ball of delicious meat. They are at this season called "Reed-birds" or "Rice-birds," from their feeding upon rice, or the seeds of the wild oats or reeds. They are slain in myriads, and exposed for sale in all the markets of the Southern cities. In "Lewis' American Sportsman," a book which contains a good deal of Natural History as well as sporting information, the author says "The war of musketry is now heard incessantly from bright morning till dark night, all along the banks of our rivers, and the markets are soon overstocked with the innocent victims of many an old rusty barrel, that is only brought into requisition in Reed-bird season, as it most frequently is at this time of the year. The birds spoil very soon after being killed, and consequently remain but a short time in the hands of the hucksters and game dealers, who are very glad to dispose of them from twelve to twenty-five cents per dozen, according to the returns of the previous day's shooting, which, of course, depends in a great measure upon the wind and weather.

"Reed-birds are shot on the meadows below our city, (Philadelphia,) or in the reeds from about; great numbers are brought down at a single shot, as they generally congregate in enormous flocks towards sunset; it is no uncommon thing to kill four or five dozen from the well-directed fire of a double-barrelled gun. It would appear incredible to state all the numbers that have been reported as killed at one discharge of an old musket or other heavy gun.

"We will, therefore, confine ourselves to one single instance, in which thirteen dozen were picked up, the result of a raking fire poured into a flock from an old fowling-piece that "scattered most confoundedly." This is not by any means the largest number we have heard of being bagged at one *coup de fusil;* but the account is well authenticated, and within bounds of credence, and we give it to our readers as such, for we have no reason to doubt the veracity of the party who told us.

"During the last year or two, a French gentleman of our city has been amusing himself in netting these Birds upon the meadows, and has been quite successful in the sport, catching immense numbers, oftentimes several hundreds at a single draw of the net. The process of taking Reed-Birds in this way is very simple, but as we are opposed to all kinds of poaching and unsportsman-like modes of taking any kind of winged game, we will not dwell longer on the subject.

"The flavor of the Reed-Bird is extremely juicy and rich, and assimilates as near as possible to that of the Ortolan of Europe, which interesting fact we very unwittingly tested at a celebrated *café*, in company with some others of our green countrymen, who were in Paris at the same time; and greatly to our surprise as well as indignation, were forced to pay for the information at the rate of a dollar per head, for these delicate little morceaux. At this rather *recherché* but expensive feast—for we devoured the poor Ortolans in nearly the same numbers as we were wont to do the Reed-Birds, at the height of the season in our own city—we think that the flavor of the French Bird was indelibly stamped upon our palate, in about perhaps the same ratio as the impression made at the time upon our purse, which, *en passant*, was not very light, we can assure the reader, as we were all Philadelphians, and consequently death on Reed-Birds, and, *in course*, Ortolans also. As far as we can recollect the particulars of this *dejeuner à la fourchette*—which, by the by, afforded us all much merriment for a long time afterwards—the company, pretty generally, when partaking of the feast, in the goodness of their hearts, or rather in the joy of their stomachs, were quite loud in their praises of the far-famed Ortolan, and all pronounced its flavor much superior to that of the poor unpretending Reedy of America. But before leaving the *café*, we must acknowledge there were some long faces and short purses in the "crowd," that seemed disposed to disparage the wellmerited compliments that were so lavishly bestowed upon the French Bird; and several were even so ungrateful, after stowing away a whole brood of them in their stomachs, as to draw invidious comparisons between the two rivals for gustatory favor. After mature reflection, however, the whole party, one and all, declared in favor of the Reed-Bird of America, at twenty sous the dozen, over the French Bird at one dollar a piece.

"As soon as the frost makes its appearance in Pennsylvania, the Reed-Bird, as well as the Rails, take their departure for the South, and it is seldom that we find either of them with us longer than October. After they leave our rivers, they continue their course South, visiting the rice-fields of the Carolinas and Georgia, and often commit great havoc in those regions.—Although thousands upon thousands of these birds have been destroyed in their route from the North, still, thousands upon thousands of them yet exist, and every gun is again brought into requisition in their new quarters, to thin down their inexhaustible numbers; but all to no purpose, as they still continue their flight in immense bodies, as the winter advances, and ultimately arrive at the termination of their long voyage in the West India Islands. In Jamaica, they are called Butter-Birds; and there, as in all other parts where they make their appearance, they are highly esteemed for the delicacy and richness of their flavor.

"Audubon states that when these Birds migrate South in the autumn, their flight is diurnal, but when returning in the spring, they travel mostly at night. Such, however, has not been the result of our observations, as we have noticed the flight of Reed-Birds many, many times during the autumn, in the still hours of night; and in the spring, we have also seen them travelling during the day.

"Another interesting particular respecting the Reed-Bird is the singular change that takes place in the plumage of the male, which begins to change in June, and by the close of the following month has approached so nearly to that of the female, that it is very difficult to distinguish one from the other. This circumstance, in connection with the fact that the plumage of all the young birds also resembles that of the females, has given rise to the vulgar notion that the male birds never return from the North, but what becomes of them every one of course is unable to conjecture.

"The plumage of the Reed-Bird is variegated and pretty, and he makes a very contented and happy captive for the Bird Fancier; soon forgetting his former life of freedom, he resigns himself to his lot, and sings merrily and cheerfully for several months in the year. His notes are agreeable, and capable of much improvement by associating him with the Canary Bird, with which we have been told he will pair. The truth of this we cannot vouch for, however.

"We were shewn, a few days since, a Reed-Bird, the plumage of which was a perfect Canary color; and if we had not recognized the bird from its general outline, we should have pronounced it *an overgrown Canary,* so complete was the change that had taken place in its appearance."

After spending the winter months in the West Indies, the Bob-link, at the return of spring, impelled by the inscrutable instinct implanted in his nature by the Creator, commences his annual journey to the North, there to bring forth and watch over the young broods, and enliven the green fields with his song. About the 1st of May they reach the Northern and Western United States, and shortly after are spread all over Canada.

Sir John Richardson saw them on the plains of the Sascatchewan in latitude 54°, north. The breeding season over, they again return to the South, again destroy the fields of the planter, and are themselves destroyed.

The generic name is derived from the Greek, (*Dolichos,*) long; and (*Onyx,*) a claw, in allusion to the length of the claws. The specific name is from the Greek, (*Oryza,*) rice; and the Latin verb, (*Voro,*) to devour.

The following is Audubon's description of the genus, which contains only the one species:—

DOLICHONYX, (Swains.) RICE-BIRD.

"Bill rather short, very stout, moderately compressed, conical; upper mandible with the dorsal line straight, a little convex at the base, and very slightly deflected at the end, its ridge rather broad, indistinct, sides rounded, edges direct, overlapping, tip rather acute; lower mandible with the angle of moderate length, very broad, dorsal outline ascending slightly convex at the base, sides erect and convex, tip acute; gape-line ascending for a fourth of its length, then direct. Nostrils small, elliptical, operculate. Plumage blended, but firm, with little gloss. Wings rather long, pointed, the first quill longest. Tail of moderate length, the feathers narrow and acuminate. Toes large; claws very long, little arched, slender, tapering to a fine point.

"Dolichonyx oryzivora, LINN. Wandering Rice-bird. Bob-o-link.—Maybird. Ortolan.

"Male with the head, cheeks, lower parts, wings, and tail, black; a band of brownish-yellow across the hind neck; the back anteriorly black, the feathers with yellowish edges, posteriorly light grey, passing into white, of which colour are the scapulars. Female with the upper parts light yellowish-brown, longitudinally streaked with blackish-brown; the lower parts light greyish-yellow, the sides streaked with dusky. In autumn, the males assume the plumage of the female.

Male 7, 11.

Passes from Texas eastward and northward. Breeds from the Middle Districts northward. Extremely abundant. Migratory.

Rice-Bunting, Emberiza oryziora, WILS. Amer. Orn. v. ii. p. 48.

Icterus agripennis, BONAP. Syn. p. 53.

Dolichonyx oryzivorus, Sharp-tailed Rice-Bird, SWAINS. & RICH. F. Bor. Amer. v. ii. p. 278.

Rice-Bird, or Bob-o-link, NUTT. Man. v. i. p. 185.

Rice-Bird, Icterus agripennis, AUD. Orn. Biog. v. i. p. 283; v. v. p. 486."

ARTICLE XXXVIII.—*Notice of the remains of a species of Seal, from the Post-pliocene deposit of the Ottawa River,*—By Professor JOSEPH LEIDY, M. D.

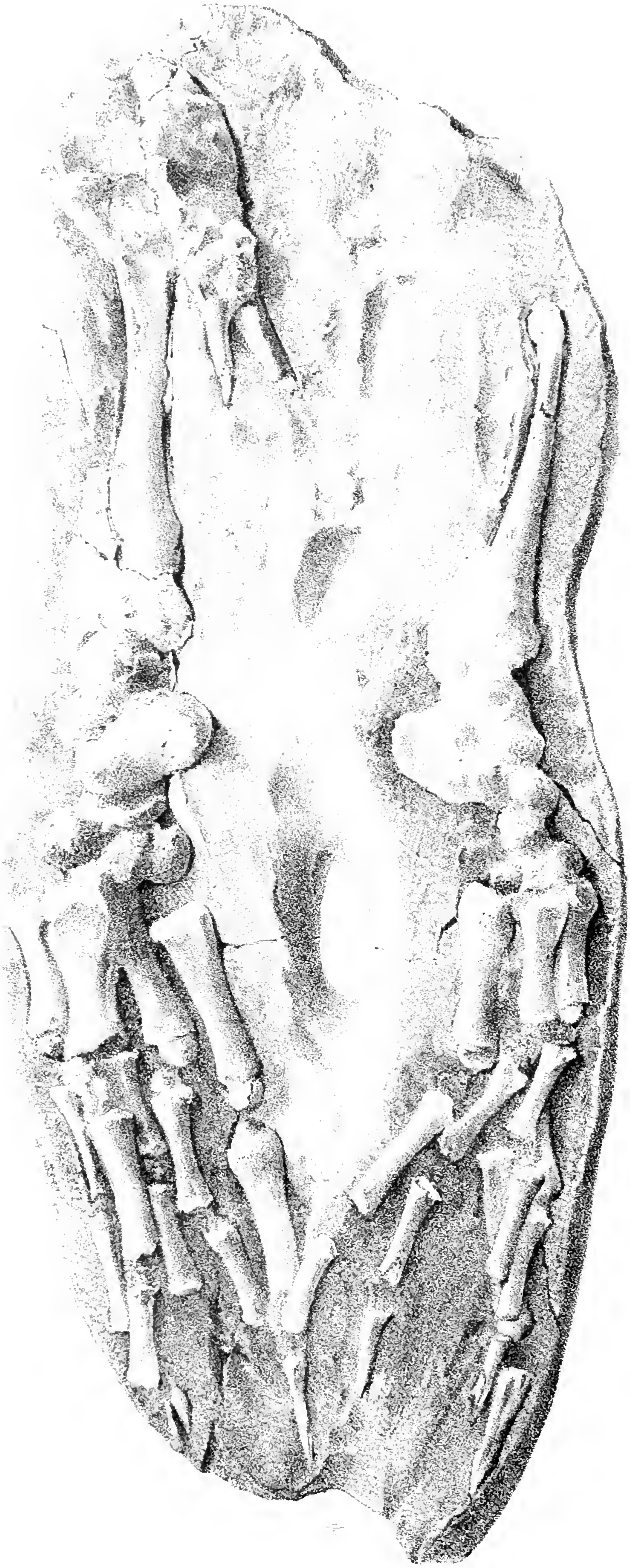
(From the Proceedings of the Academy of Natural Sciences, Philadelphia.)

"E. Billings, Esq., of Ottawa, West Canada, recently sent to the Academy, for the inspection of its members and for description, a specimen consisting of a slab or portion of a concretion of indurated clay, containing some imbedded bones, which Mr. B. observes, in a letter accompanying the specimen, 'appear to him to be those of the extremities of a small animal of aquatic habit.' Mr. B. further states, 'the specimen was discovered by Mr. Peter McArthur, in a bed of blue clay containing boulders and marine shells and fishes. The locality is in the township of Gloucester, county of Carleton, Canada West, about nine miles east of the City of Ottawa. From this city the river Ottawa runs easterly for about sixty miles, in a channel excavated through a bed of the glacial drift, composed in some places of clay, and in others of sand, gravel and boulders. Where the specimen was discovered, the bank of the river is of clay about thirty feet high, at the time of low water. The water washes out of the bank numerous nodules of the clay, which are consolidated into a pretty hard kind of stone. Many of these nodules, when split open are found to contain shells, or the skeletons of fishes, often beautifully preserved. The species of shells found up to the present time are *Tellina groenlandica*, *Mytilus edulis*, *Saxicava rugosa*, and a small rostrated one like a *Leda*; and of fishes two species, *Mallotus villosus* and *Cyclopteris lumpus*. They also contain leaves of trees, broken twigs and grass, showing that there was land at no great distance. There is a ridge of low metamorphic hills on the north shore of the river, extending for a great distance parallel with and near the stream. On the south side the country is level, and underlaid with lower Silurian rock, Utica slate, Trenton, Black River, Bird's-eye and Chazy limestones, with here and there a strip of the lower rocks brought up to the surface by undulations. I think there was an ancient valley excavated in those rocks before the period of the drift, that it was filled up during that period, and that the river is now cleaning it out again.'

The bones referred to prove, on examination, to be those of the greater portion of the hinder extremities of a young Seal, but whether of a species distinct from those now found living in the neighboring seas, is a question only to be determined by careful comparison with the corresponding parts of the recent animals. The soft distal extremities of the tibia and fibula are crushed together. The bones of the ankle and foot are well preserved, but the epiphyses of the latter are separated and only partially developed. The matrix in the vicinity of the bones, is marked by the impressions of the hairs and skin, which enveloped them.

"SIR W. E. LOGAN, in a report on the "Geological Survey of Canada," (1850, '51, p. 8,) refers the deposit in which the above described specimen was found, and similar deposits of the St. Lawrence and its tributaries, to the

Plate III



T. Sinclair's lith. Phil^a

post-tertiary period; and he further observes, that in these deposits, "the remains of whales, seals, and two species of fishes, and many marine shells of those species still inhabiting the Gulf of St. Lawrence, are found;" from which remarks, together with those of Mr. Billings, and the appearance of the fossil itself, we are inclined to suspect the Seal of the Ottawa has its descendants yet sporting on the sea border of the Canadas.

"Independent of all other considerations, the specimen is interesting, as exhibiting the same process at the present geological period, which for so many successive ages has preserved the remains of vegetables and animals, which are now examined by the palæontologist as so many iconographic illustrations of life in the history of our planet.

"Plate III. Representation, two-thirds the size of nature, of the greater portion of the bones of the hinder extremities of a young Seal, partially imbedded in one-half of concretion of indurated clay, from a post-pliocene deposit of the Ottawa River, Canada."

MISCELLANEOUS — Notices of Books, &c.

Descriptions of some remains of Fishes from the Carboniferous and Devonian Formations of the United States, and also of some extinct Mammalia. By Professor Joseph Leidy, M.D., Philadelphia.

We have received from the author, a copy of the above-named beautifully illustrated Memoir. Among the Mammalia, is described the skull of an extinct species of wolf discovered in the banks of the Ohio River, where it was associated with the remains of the Megalonyx Bison, Virginian Deer, the extinct Horse of America, (*Equus Americanus,*) and the Tapir. Prof. Leidy says "The fragment, in comparison with the corresponding portion of the skull of the common wolf of Europe, and its American congeners, differs only in being larger, and in presenting slight variations in the teeth, not however greater than those found among different varieties, or perhaps even individuals of recent wolves." He proposes for the fossil, the name, (*Canis primævus*). We should have noticed this discovery in our article on the wolf, but overlooked it.

Another specimen is a fragment of the lower jaw, and an upper molar tooth of an extinct Bear, (*Ursus amplidens,* Leidy,) which appears to have been intermediate in size between the Common Black Bear (*Ursus Americanus,*) and the Grizzly Bear, (*Ursus ferox.*) It was found in a ravine in the neighbourhood of Natchez, Mississippi. In the same deposit were discovered the remains of the Mastodon, Megalonyx, Mylodon, and other creatures of long lost races. The Black Bear, the Virginian Deer, and the Buffalo, had made their appearance in America before these gigantic animals became extinct, their bones being found in the same association.

Another curious fossil described by the Professor, is the jaw of an animal of the Camel family, (*Camelops Kansanus,* Leidy,) found in the Kansas territory.

Dr. Isaac Lea has sent us a pamphlet in which he describes twenty-five new species of Uniones, chiefly from the waters of the far-off kingdom of Siam. The extraordinary genus (*Unio,*) to which these shells belong, consists of a multitude of species distributed throughout all the fresh waters of the globe. In Lea's Synopsis of the Family of Naiades, published in 1852, there are mentioned 401 species in a recent state, 97 fossil and 84 others noticed by authors, whose descriptions appear to be doubtful. In addition to these there were then known a sufficient number of forms belonging to the closely allied genera of *Anodon, Margaritana,* &c., to make the total 767. Many species have been since contributed, and the number is now probably over 800. Among the 25 new species described, are 14 from Siam, 1 from Burmah, 2 from the Cape of Good Hope, 1 from Sina River in India, 1 from Brazil, 1 from River Macacou, Rio de Janiero, Brazil, New Grenada, 1 from Australia, 1 from Rio Plata, 1 from Mocha in Asia, 1 from River Amazon, 1 from Medellin River, Mexico. Of all the families of the Mollusca, none has excited more intense interest in the scientific world than the Naiades, of which the clam shells of our Canadian rivers are examples.—Among them are many very beautiful shells, and of almost every form seen in the whole range of all the other species of bivalves. Some of them are very rare and eagerly sought after. The physiological structure of the animals has engaged a great deal of the attention of the best anatomists, while the systematic zoologist has encountered here several problems of no ordinary difficulty. In this, his favorite department of science, Dr. Lea is considered the leader in all parts of the world, and has published a number of beautifully illustrated works. The Pamphlet before us also contains a paper on the new Red Sandstone of Pennsylvania, and descriptions; a new sub-genus of Naiades; a new species of *Triquetra;* and some new fresh-water shells from California.

Kirby & Spence's Entomology.—Mr. Dawson of Montreal has a supply of the new and cheap English edition of this highly interesting work. Our young countrymen who desire to make themselves acquainted with the manifold wonders of the insect world would do well to provide themselves with this book. We look upon this work as of the same importance in Entomology that Lyell's Principles are in Geology. It contains a vast fund of information relating to the Metamorphoses, Food, Stratagems, Habitations, Societies, Motions, Instincts, &c. of Insects, without which no sound knowledge of this delightful science can be acquired unless by years of labour. The book contains over 600 closely printed pages, and is sold for only 7s. 6d.

The Works of Audubon. — We would strongly recommend that every Public Library in Canada should purchase a set of the Works of the great Ornithologist and Naturalist, Audubon. Those whose funds are not sufficiently abundant to afford the very expensive editions may, without much effort, procure those less costly. It is scarcely necessary to state, that a Library with any one of the editions must rank immeasurably above others not thus furnished. These works are for sale by C. S. Francis & Co. No. 252, Broadway, New York; and for the information of parties who may desire to purchase, we shall give their advertisement entire, as we find it in their Catalogue.

THE

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BY E. BILLINGS.

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ARTICLE XXXIX.—*Natural History of the Wolverene or Carcajou, (Gulo Luscus.)*

GENUS GULO.—STORR.

DENTAL FORMULA.

Incisive $\frac{6}{6}$; *Canine*, $\frac{1}{1}$—$\frac{1}{1}$; *Molar*, $\frac{5}{6}$—$\frac{5}{6}$.

GENERIC CHARACTERS.—"The three first molars in the upper and the four first in the lower jaw, small; succeeded by a larger carnivorous or trenchant tooth, and a small tuberculous tooth at the back. In the upper jaw the three first molars are uni-cuspidateous, and may be called false-carnivorous teeth, increasing successively in size; the following or carnivorous tooth is large and strong, furnished with two points on the inner side, and a trenchant edge in front; the last tooth is small, and tuberculous or flattish. In the lower jaw the first four molars are false, each presenting only one point or edge; the fifth is long and large, with two trenchant points; the last molar is nearly flat. All the teeth touch each other successively." (Cuvier.) Head of moderate length; body long; legs short; tail bushy; feet with five deeply divided toes, terminated by long curved nails; no glandular pouch in some of the species, but a simple fold beneath the tail; habits carnivorous and nocturnal. The generic name is derived from the Latin *gulo*, a glutton. Four species of this genus have been described: one existing in the Arctic regions of both continents; two in South America, and one in Africa." (Audubon and Bachman, vol. I, page 202.) The North American species is commonly known by the name of the *Wolverene* or *Carcajou.*

GULO LUSCUS, (Linn.)

SPECIFIC CHARACTERS.—"*Dark brown passing into black above, a pale band upon each side, running from the shoulders round the flanks, and uniting on the hips; tail with long bushy hairs.*"

The earlier writers upon the Natural History of Northern Europe and America published many gross misrepresentations upon the Wolverene, affecting materially not only his personal appearance but his habits and general character. According to several authors the length of his tail is so extraordinary that it can be wound several times round his body, while his voracity exceeds that of any other denizen of the forest. The account given in Goldsmith's Natural History, although intended for the truth, is in fact a very good summary of all the errors concerning the habits of this animal extant at the date of the publication of that work: "It is chiefly in North America (he says) that this voracious creature is seen, lurking among the thick branches of trees, in order to surprise the deer, with which the extensive forests of that part of the world abound. Endued with a degree of patience equal to its rapacity the glutton singles out such trees as it observes marked by the teeth or the antlers of the deer, and it is known to remain there watching for several days together. If it has fixed upon a wrong tree, and finds that the deer have either left that part of the country, or cautiously shun the place, it reluctantly descends, pursues the beaver to its retreat, or even ventures into the water in pursuit of fishes. But if it happen that, by long attention and keeping close, at last the elk or the reindeer happen to pass that way, it at once darts upon them, sticks its claws between their shoulders and remains there unalterably firm. It is in vain that the large frighted animal increases its speed, or threatens with its branching horns, the glutton having taken possession of its post, nothing can drive it off; its enormous prey drives rapidly along amongst the thickest woods, rubs itself against the largest trees, and tears down the branches with its expanded horns; but still its insatiable foe sticks behind, eating its neck, and digging its passage to the great blood vessels that lie in that part. Travellers who wander through these deserts often see pieces of the glutton's skin sticking to the trees against which it was rubbed by the deer. But the animal's voracity is greater than its feelings, and it never seizes without bringing down its prey; when therefore the deer, wounded and feeble with the loss of blood, falls, the glutton is seen to make up for its former abstinence by its present voracity. As it is not possessed of a feast of this kind every day, it resolves to lay in a store to serve it for a good while to come. It is indeed amazing how much one of these animals can eat at a time. That which was seen by Mr. Velein, although without exercise or air, although taken from its native climate, and enjoying but an indifferent state of health, was yet seen to eat thirteen pounds of flesh every day, and yet remain unsatisfied. We may therefore easily conceive how much more it must devour at once, after a long fast, of food of its own procuring, and in the climate most natural to its constitution. We are told accordingly that from being a lank, thin animal, which it naturally is, it then gorges in such quantities that its belly is distended and its whole figure seems to alter. Thus voraciously it continues eating till, incapable of any other animal function, it lies totally torpid by the animal it has killed; and in this situation it continues for two or three days. In this loathsome and helpless state it finds its chief protection from its horrid smell, which few animals care to come near; so that it continues eating and sleeping till its prey be devoured, bones and all, and then it mounts a tree in quest of another adventure."

He then proceeds to state that the glutton prefers putrid flesh to that of the animals newly killed, that it pursues the beaver, plunders the traps and snares set by the hunters, digs open graves and devours the bodies interred therein, and is so universally predacious that the natives of the countries where the animal inhabits hold it in detestation, and usually term it the Vulture of quadrupeds. Another author, Olaus Magnus, from whom perhaps Goldsmith compiled much of his history, says that the Arctic fox provides for the glutton in the same manner that the jackal was reputed to hunt for the lion. And Gmelin informs us that our animal watches large beasts like a robber, or surprises them when asleep, and that after having darted down from a tree like an arrow upon the reindeer or elk he sinks his teeth into its body and gnaws its flesh till it expires, after which he devours it at his ease and swallows both hair and skin.

It is frequently the task of the modern Naturalist to strip the accounts of those more ancient of much that is marvellous, and those who have recently and without prejudice studied the Wolverene or glutton find him a very ordinary animal much resembling in appearance a small brown bear, its length being scarcely three feet and its height not much exceeding one foot. Its head is of moderate size, broad on the hinder part, much arched, rounded on all sides; nose obtuse, naked; eyes small; ears short, broad, rounded, and partially hidden by the surrounding fur. The body is long in proportion to the height of the animal, and its tail instead of being long enough to wind round the body is only seven or eight inches in length. The legs are short and stout, and each one of the five toes is armed with a rounded and pretty sharp claw. The feet are broad, and clothed on the under surface with woolly hairs, so that the tracks made on the snow by the animal are large and are said to be not very unlike those of the bear. The fur is also like that of the bear. It is in general dark brown approaching to black. A pale reddish band commences behind the shoulder, and running along the flanks, turns up on the hip, and unites on the rump with similar markings on the opposite side. The nose, eyes and whiskers are black, legs and tail brownish black, and claws dark brown.

As to the habits of the Wolverene, Sir John Richardson says that it feeds chiefly on the carcases of animals that have been killed by accident. It also devours meadow-mice, marmots and other rodentia, and occasionally destroys disabled quadrupeds of a larger size; it possesses neither the agility nor the strength to destroy deer or other large game, as is stated by the early writers. Richardson saw one chasing an American hare, which was at the same time harassed by the large white owl. The speed of the hare is, however, greater than that of the Wolverene. All writers agree that it follows the footsteps of the trapper in order to prey upon the hare, marten, beaver or other animal that may be caught in them, or to feed upon the bait. It is probable, however, that in such excursions the animal is directed by scenting the bait at a distance, and thus finds its way to the traps. We cannot believe that it, as any other North American animal, is possessed of sufficient intelligence to understand the mission of the trapper, whose foot-prints it may happen to find in the snow; and we know by having practiced the same art in our youth in the valley of the Ottawa, that trappers are in the habit of trailing a roasted bird, squirrel or piece of flesh from one trap to another, knowing that the marten will follow the scent and thus be guided to the trap. It is not therefore the footsteps of the trapper, but the scent of the bait or trail that the Wolverene in all probability follows. Audubon and Bachman say that this animal has always existed sparingly in the United States, and only in the northern portion of the Union. It is still found, although rarely, in Canada. The metropolis of the species is in the cold north. Occasionally a pack of furs brought from the back settlements of Canada contains a skin of the Wolverene. Audubon killed one in the Ransselaer County in the State of New York; it had its den in a narrow cave in the rocks, where it had made a large nest for itself of dried leaves.

The same species is found on both continents. It inhabits the most northern points of Europe and Asia, occurring in Sweden, Norway, Lapland and Siberia, as well as in some of the Alpine regions, and in the forests of Courland and Poland. In North America it is found throughout the whole Arctic Circle. They were caught to the number of ten or twelve every winter by Capt. Cartwright in Labrador. It exists at Davis Straits, and has been traced across the continent to the shores of the Pacific. It is found on the Russian Islands of Alaska. Richardson remarks: "It even visits the islands of the Polar Sea, its bones having been found in Melville Island, nearly in latitude 75°." It occurs in Canada, although diminishing in numbers the further we proceed southerly. Specimens have been procured in Newfoundland and in Maine.

In the expedition of Sir John Ross, as described by Captain I. C. Ross, R. N. and R. S., the following anecdote of this species is related: "In the middle of winter time, or three months before we abandoned the ship, we were one day surprised by a visit from a Wolverene, which, hard pressed by hunger, had climbed the snow wall that surrounded our vessel, and came boldly on deck, where the crew were walking for exercise; undismayed at the presence of twelve or fourteen men, he seized upon a canister that had some meat in it, and was in so ravenous a state that whilst busily engaged at his feast he suffered me to pass a noose over his head, by which he was immediately secured and strangled." The animal had evidently become desperate by extreme hunger.

Audubon says: "We have seen this species in confinement in Europe; the specimens came, we are informed, from the north of that continent. In Denmark, a keeper of a small caravan of animals, allowed us the privilege of examining a Wolverene which he had exhibited for two years; we took him out of his cage; he was very gentle, opened his mouth to enable us to examine his teeth, and buried his head in our lap whilst we admired his long claws, and felt his woolly feet; he seemed pleased to escape from the confinement of the cage, ran round us in short circles, and made awkward attempts to play with and caress us, which reminded us very much of the habit of the American black bear. He had been taught to sit upon his haunches and hold in his mouth a German pipe. We observed he was somewhat averse to the light of the sun, keeping his eyes wholly closed when exposed to its rays. The keeper informed us that he suffered a good deal from the heat in warm weather, that he drank water freely, and ate meat voraciously, but consumed more in winter than in summer. There was in the same cage a marmot from the Alps, to which the Wolverene seemed much attached. When returned to the cage he rolled himself up like a ball, his long shaggy hairs so completely covering his limbs that he presented the appearance of a bear skin rolled up into a bundle."

"The Wolverene produces young once a year in number from two to four, and the cubs are covered with a downy fur of a pale cream colour." (Richardson.) The fur bears a great similarity to that of the black bear, but is not so long nor of so much value.

The Glutton (*Gulo luscus*) is the Carcajou of La Hontan and the French Canadians; Quickhatch (*Ursulo affinis Americana*) of Catesby (*Carolina*); Quickhatch of the English residents at Hudson's Bay; Quickhatch, or Wolverene, of Ellis; Wolverene of Pennant; Wolverin, Quiquihatch, or Carcajou, of Graham (manuscripts); Kablee-arioo of the Esquimaux of Melville Peninsula; Ka e week of the Esquimaux of Boothia Felix; Nag-hai-eh of the Chippeways; Ommeethatsees, Okeecoohagew, and Okeecoohawgees (whence, as Sir John Richardson observes, the term Quickhatch of the European labourers in the service of the Hudson's Bay Company is evidently derived), of the Crees, or Algonquins; Rosomak of the Russians; Jarf, Filfress, of the 'Fauna Suecica'; Timmi of the Kamtschatkans; Haeppi of the Koratzki; Glouton of the French; *Gulo* of Olaus Magnus; *Gulo*, Vielfrass, of Gener; *Hyæna* and *Ursus Freti Hudsonis* of Brisson; *Mustela Gulo* and *Ursus luscus* of Linnæus; *Ursus Gulo* of Pallas and Gmelin; *Taxus Gulo* of Tiedemann; *Gulo arcticus* of Desmarest; *Gulo vulgaris* of Griffith's Cuvier; *Gulo luscus* of Sabine.

ARTICLE XL.—*On the Loup Cervier, or Canadian Lynx, (Lynx Canadensis), and the Bay Lynx or Wild Cat of the United States, (Lynx Rufus.)*

GENUS LYNX.

DENTAL FORMULA.

Incisive $\frac{6}{6}$; *Canine* $\frac{1}{1}$—$\frac{1}{1}$; *Cheek-Teeth* $\frac{3}{3}$—$\frac{3}{3}$=28.

GENERIC CHARACTERS.—The teeth of the genus Lynx do not differ from those of the tame cats, except that there is one less on each side in the upper jaw. The canines are large and strong; and the small false molars, next to the canines, which exist in the large long tailed cats, such as the lion, tiger, panther, cougar, etc., as well as in the common domestic cat, are here wanting. There is one false molar, or conical tooth, on each side, one carnivorous, with three lobes and a tubercle, or blunted heel, on the inner. The third cheek-tooth is rather small, and is placed transversely. In the lower jaw there are on each side two false compressed simple molars and one canine, which is bicuspid. The head is short, round and arched; jaws short; tongue aculeated; ears short, erect, more or less tufted; fore feet with five toes, hind feet with only four; nails retractile; tail shorter than the head, although nearly as long in a few instances.

This genus has been separated from the old genus FELIS on account of the tufted ears, shorter bodies and tails, and also the slight differences in the teeth. The generic name is from the Greek *lunyx*, a lynx. There are eight species, one in Africa, two in Persia, one in Arabia, two in Europe, and two in North America. (Aud. and Bach.)

Both of the American species are found in Canada. They are described as follows:

1. LYNX RUFUS.—Guldenstaed. COMMON AMERICAN WILD CAT, BAY LYNX.

SPECIFIC CHARACTERS.—*Tail nearly as long as head; extremity on the upper surface black, tipt with more or less white; a whitish spot on the hinder part of the ear, bordered with black; general colour reddish, brown in autumn, and winter ashy brown; in spring and summer, soles of feet naked.*

2. LYNX CANADENSIS.—Geoffrey. THE LOUP CERVIER, OR CANADA LYNX.

Specific Characters.—*Longer than L.Rufus; ears triangular, tipt with an upright slender tuft of coarse black hairs; tail shorter than the head; soles hairy; general colours, grey above, a little clouded with irregular darker spots, lighter beneath.*

The skins of the Loup Cervier may be seen in the collections of almost every extensive fur dealer in Canada, although the animal itself is not often to be met with, unless by those sportsmen or hunters who penetrate into the more retired recesses of the forest. The settlements are seldom visited by this beast of prey, its habits being such that it finds in general a sufficiency of food in the woods, and is therefore not often compelled by famine to forage in the farm yard. There can be little doubt, however, that sometimes the wolf is blamed for carrying off a lamb which has feasted the lynx. Its prey consists of such small animals as the northern hare, the grey rabbit, squirrels, mice, grouse, and birds of various kinds. It is said that in the northern regions it preys upon the Arctic fox (*Vulpes lagopus*,) and that it also there makes great havoc among the lemmings. When it enters a place frequented by rabbits it seldom leaves the locality until it has killed them all. One was found with its mouth full of the sharp quills of the porcupine, its head greatly inflamed, and its sight nearly destroyed in consequence. There are some accounts of its attacking deer, but although its strength is doubtless sufficient to warrant an encounter with such large prey, yet the habit of the lynx is more like that of the common cat to seek its food among animals smaller and weaker than itself.

From the great size of its claws and teeth, and its formidable appearance, the Canada Lynx has acquired a reputation for ferocity, cunning and daring, to which it is not entitled. All that has been said of the Wolverene with respect to its leaping from trees upon the backs of the deer and elk has also been applied to this animal. In fact one of its common names, *Loup Cervier*, or "*Deer Wolf*," was bestowed upon it from its supposed habit of pouncing upon and destroying deer. Although, however, strongly built, and capable of climbing trees with ease, the lynx is timid, and at the sight of man cowardly, and a very small dog will put it to flight instantly. It swims well, breeds once a year, having two young at a time, is easily taken in traps; and the Indians eat its flesh. When attacked by dogs, and cornered up, it fights like a cat, spitting and striking with its sharp claws, with which it can inflict severe wounds.

This animal has a short round head, large eyes, long, thick and strong legs, a short tail, and erect ears, which are tufted with black hairs. Its feet are completely covered by long woolly fur, so that its tracks upon the snow are very large, and do not show any impressions of the toes; its steps are short. The general colour is grey, with indistinct brownish spots.

It is found more or less abundantly all over the British Provinces of North America, being a species of the Arctic and North Temperate Zones. It is not found in the Southern States, and is less common in the Northern States than it is in Canada, New Brunswick, and thence northerly.

The Wild Cat, Lynx Rufus.

The common American Wild Cat differs from the Canadian Lynx principally in being smaller and of a yellowish or reddish brown color instead of gray. Although in appearance a ferocious looking animal, yet it is cowardly, and has never been known to attack any but animals smaller than itself. In those portions of the States where it is not well known, there are always many traditions afloat, attributing to this species the character of a fierce and dangerous animal. The urchin, seldom partial to strange cats of even the domestic species, generally regards that portion of his road to school, which happens to traverse some lonely swamp reputed to be the haunt of a wild cat, with especial aversion; he treads softly, breathes deeply, and looks around him most suspiciously, expecting every moment to be pounced upon by a savage with claws and teeth of unknown length and sharpness; as he draws near the opening upon the far side, his heels involuntarily become much lighter, and not unfrequently the dreaded passage terminates in a nimble run, until some safer spot is gained. In after years he learns that this dread of an enemy may be classed among the "lost fears," and like, many of the brighter fancies of childhood, without foundation. There appears to be no well authenticated instance of an attack by the wild cat upon any animal larger than a lamb or a young pig.

Audubon states that this animal "is fond of swampy retired situations, as well as the wooded sides of hills, and is still seen occasionally in that portion of the Alleghany Mountains which traverses the States of Pennsylvania and New York. It is abundant in the cane brakes bordering the lakes, rivers, and lagoons of Carolina, Louisiana, and other southern and south-western

States. This species also inhabits the mountains and undulating or rolling country of the Southern States, and frequents the thickets that generally spring up on deserted cotton plantations, some of which are two or three miles long, and perhaps a mile wide, and afford, from the quantity of briars, shrubs and young trees of various kinds which have overgrown them, excellent cover for many quadrupeds and birds. In these bramble covered old fields the "Cats" feed chiefly on the rabbits and rats that make their homes in their almost impenetrable and tangled recesses; and seldom does the Wild Cat voluntarily leave so comfortable and secure a lurking place, except in the breeding season, or to follow in very sultry weather the dry beds of streams or brooks, to pick up the catfish, &c., or crawfish and frogs that remain in the deep holes of the creeks during the drought of summer.

"The Wild Cat not only makes great havoc among the chickens, turkeys and ducks of the planters, but destroys many of the smaller quadrupeds, as well as partridges and such other birds as he can surprise roosting on the ground. The hunters often run down the Wild Cat with packs of fox-hounds. When hard pressed by fast dogs, and in an open country, he ascends a tree with the agility of a squirrel, but the baying of the dogs calling his pursuers to the spot, the unerring rifle brings him to the ground, when, if not mortally wounded, he fights fiercely with the pack until killed. He will, however, when pursued by hunters with hounds, frequently elude both dogs and huntsmen, by an exercise of instinct so closely bordering on reason that we are bewildered in the attempt to separate it from the latter. No sooner does he become aware that the enemy is on his track than instead of taking a straight course for the deepest forest he speeds to one of the largest old fields overgrown with briary thickets in the neighbourhood, and having reached this tangled maze, he runs in a variety of circles, crossing and recrossing his path many times; and when he thinks the scent has been sufficiently diffused in different directions by this manœuvre to puzzle both men and dogs, he creeps slyly forth, and makes for the woods, or for some well known swamp; and if he should be lucky enough to find a half dried up pond, or a part of the swamp on which the clayey bottom is moist and sticky, he seems to know that the adhesive soil, covering his feet and legs, so far destroys the scent that although the hounds may be in full cry on reaching such a place, and while crossing it, they will lose the track on the opposite side, and perhaps not regain it without some difficulty and delay.

" At other times the " Cat," when chased by the dogs, gains some tract of " burnt woods," common especially in the fine lands of Carolina, where fallen and upright trees are alike blackened by the fire that has run among them, burning before it every blade of grass, every leaf and shrub, and destroying many of the largest trees, in its furious course; and here the charcoal and ashes on the ground, after he has traversed the burnt district a short distance, and made a few leaps along the trunk of a fallen tree, that has been charred in the conflagration, will generally put any hounds at fault. Should no such chance of safety be within his reach, he does not despair, but exerting his powers of flight to the utmost, increases his distance from the pursuing pack, and following as intricate and devious a path as possible, after many a weary mile has been run over, he reaches a long fallen trunk of a tree, on which he may perchance at some previous time have baffled the hunters as he is now about to do. He leaps on to it, and hastily running to the further end he doubles and returns to the point from which he gained the tree, and after running backward and forward repeatedly on the fallen trunk, he makes a sudden and vigorous spring, leaping as high up into a tree some feet distant as he can; he then climbs to its highest forks, crouches, and, closely squatted, watches the movements of his pursuers. The dogs are soon at fault, for he has already led them through many a crooked path; the hunters are dispirited and uneasy, and perhaps the density of the woods, or the approach of night favours him; the huntsmen call off their dogs from the fruitless search, and give up the chase, and shortly after the escaped marauder descends leisurely to the earth, and wanders off in search of food, and to begin a new series of adventures."

The Wild Cat is a great destroyer of the eggs of birds, and never finds the nest of a grouse, partridge, wild turkey, or other bird, without sucking every egg in it. The following is a method of capturing the animal, practiced in the Southern States, where it is abundant: " A large and strong box trap is constructed, and a chicken, placed at the farthest end of it from the door, is tied by one leg so that he cannot move; there is a stout wire partition about half way between the fowl and the door, which prevents the Cat, when entering the trap, from seizing the bird; the trap is then set so that when the animal enters the door closes behind him with a spring, commonly the branch of some tree bent down for that purpose, and released by a trigger set at the entrance or just within the trap. These traps are placed in different points of the plantations, or in the woods, and the Wild Cat is generally attracted by the crowing of the cock at the dawn of day."

The Cats are often caught in this way, and they do not therefore seem to possess the cunning of the fox, enabling the latter to avoid the traps set for racoons. Audubon and Bachman, from whose work the above particulars are extracted, state that they have seen this animal taken from the common log traps set for racoons, and that they are often found in the steel traps baited and set for otters.

When this animal discovers a flock of wild turkeys he follows them for a little distance, to ascertain their direction, and then makes a rapid detour so as to get in front of them; he then conceals himself, and when they have arrived within a convenient distance springs into their midst, and seldom fails to secure one of the number.

When kept in confinement they shew their close relationship to the common cat by purring and mewing loud enough to be heard at some distance. They hunt both by night and by day. The female makes a comfortable nest of dry moss and leaves in a hollow log or tree, and there brings forth her young, from two to four at a time.

Audubon and Bachman state that "the geographical range of this species is very extensive, it being found to inhabit portions of the continent from the tropics as far north as 60 degrees. It abounds in Texas, Louisiana, Florida, Georgia, and in both the Carolinas, and is found in all the States east of these, and likewise in New Brunswick and Nova Scotia; we have seen it on the shores of the Upper Missouri, more than a thousand miles above St. Louis. We examined one that had been taken a few hours before by some hunters in Erie County in the State of New York, and have heard of its existing, although rather sparingly, in Upper Canada, where it has been occasionally captured."

ARTICLE XLI.—*Natural History of the Raccoon,*(*Procyon Lotor.*)

GENUS PROCYON.—Storr.

Dental Formula.

Incisive $\frac{6}{6}$; *Canine* $\frac{1}{1}$—$\frac{1}{1}$; *Molar* $\frac{6}{6}$—$\frac{6}{6}$=40.

Generic Characters.—"Muzzle pointed and projecting beyond the lower jaw; ears short and oval; tail bushy and long; feet five toed, with strong nails not retractile; soles of feet (posterior) naked; the species rest on the heel, but walk on the toes. Mammæ, six ventral; there is a gland on each side of the anus which secretes a slightly offensive fluid.

"The generic name is derived from the Greek *pro*, before, and *kron*, a dog.

"Two species only have been noticed, one in the northern and the other in the southern parts of North America." The northern species is that which occurs in Canada.

Procyon Lotor.—Linn.

Specific Characters.—"*Body above grayish, mixed with black; ears, and beneath, whitish; a black patch across the eye; tail, with four or five annulations of black and gray.*"

The body of the Raccoon is rather stout, the legs of moderate length, and the appearance of the animal would indicate that although he is not intended for great speed, he is still by his compact and well organized structure, his strong musculous limbs and short and stout claws, capable of a tolerably rapid race, and is able to climb, although not with the agility of the squirrel still with greater alacrity than his near relative the bear.

"His head is rather round; nose tapering, sharp, and snout moveable; point of nose naked; eyes round, and of moderate size; moustaches few, very rigid, resembling bristles, extending to the chin; ears low, erect, elliptical, with their tips much rounded, clothed with hair on both sides; on the inner surface the hairs are longer and less dense; tail of moderate length and bushy. In its feet the Raccoon is partially plantigrade; hence it was classed by Linnæus among the bears, under the genus *Ursus*; soles of feet naked. When it sits, it often brings the whole hind sole to the ground, resting in the manner of the bears. The canine teeth are large and extend beyond the lips; the nails are strong, hooked and sharp, not covered with hairs. The body is densely clothed with two kinds of hairs; the outer and longer, long and coarse; the inner, softer and more like wool.

"*Colour.*—Point of nose, and soles of feet black; nails of dark brown; moustaches nearly all white; ears, lips, above the snout and chin, dingy white; above the eyes, and around the forehead, light gray. A dark brown patch extends from each side of the neck and passes the eyes over the nose nearly reaching the snout, and gradually fading on the forehead into the colours of the back; eyes black; the longer hairs on the back are dark brown at the roots, then yellowish white for half their length, and are broadly tipped with black; the softer fur beneath, pale brown throughout the whole body; on the sides and belly, the longer hairs are dingy white from the roots; the tail has about six distinct black rings, and is tipped with black; these rings alternate with five light yellowish brown annulations."

This animal is well known all over Canada and the United States as far as south as the Gulf of Mexico. It is said to extend its geographical range further towards the north on the Pacific west of North America, than on that of the Atlantic. The Hudson's Bay Company procure skins in the Red River Settlement, and it appears that that locality is about its extreme northern range. Although somewhat common in this Province especially in the newer settlements, its history is not very generally known, and yet few animals are more interesting in their habits. We think the following account given by Audubon and Bachman can scarcly be read without amusement:

HABITS.

The Raccoon is a cunning animal, is easily tamed, and makes a pleasant monkey-like pet. It is quite dexterous in the use of its fore-feet, and will amble after its master in the manner of a bear, and even follow him into the streets. It is fond of eggs, and devours them raw or cooked with avidity, but prefers them raw of course, and if it finds a nest will feast on them morning, noon and night without being satiated. It will adroitly pick its keeper's pockets of anything it likes to eat, and is always on the watch for dainties. The habits of the muscles (*unios*) that inhabit our fresh water rivers are better known to the Raccoon than to most conchologists, and their flavour is as highly relished by this animal as is that of the best bowl of clam soup by the epicure in that condiment.

Being an expert climber, the Raccoon ascends trees with facity, and frequently invades the nest of the woodpecker, although it may be secure against ordinary thieves, by means of his fore-feet getting hold of the eggs or the young birds. He watches too the soft-shelled turtle when she is about to deposit her eggs, for which purpose she leaves the water, and crawling on to the white sand-bar, digs a hole and places them underneath the heated surface. Quickly does the rogue dig up the elastic ova, although ever so carefully covered, and appropriate them to his own use, notwithstanding the efforts of the luckless turtle to conceal them.

Sometimes by the margin of a pond, shrouded, or crouched, among tall reeds and grasses, Grimalkin-like, the Raccoon lies still as death, waiting with patience for some ill-fated duck that may come within his reach. No negro on a plantation knows with more accuracy when the corn (maize) is juicy and ready for the connoisseur in roasting ears, and he does not require the aid of fire to improve its flavour, but attacks it more voraciously than the squirrel or the blackbird, and is the last to quit the cornfield.

The favourite resorts of the Raccoon are retired swampy lands well covered with lofty trees, and through which are small water-courses. In such places its tracks may be seen following the margins of the bayous and creeks, which it occasionally crosses in search of frogs and muscles which are found on their banks. It also follows the margins of rivers for the same purpose, and is dexterous in getting at the shell-fish, notwithstanding the hardness of the siliceous covering with which nature has provided them. In dry seasons, the receding waters sometimes leave the muscles exposed to the heat of the sun, which destroys their life and causes their shells to open, leaving them accessible to the first animal or bird that approaches.

In the dreary months of winter, should you be encamped in any of the great western forests, obliged by the pitiless storm to remain for some days, as we have been, you will not be unthankful if you have a fat Raccoon suspended on a tree above your camp, for when kept awhile, the flesh of this species is both tender and well-flavoured.

The Raccoon when full grown and in good condition we consider quite a handsome animal. We have often watched him with interest, cautiously moving from one trunk to another to escape his view. His bright eye, however, almost invariably detected us ere we could take aim at him, and he adroitly fled into a hollow tree and escaped from us.

We once met with one of these animals whilst we were traveling on horseback from Henderson to Vincennes, on the edge of a large prairie in a copse, and on approaching it ran up a small sapling from which we shook it off with ease; but as soon as it reached the ground it opened its mouth and made directly towards us, and looked so fierce, that drawing a pistol from our holsters, we shot it dead when it was only a few feet from us.

The young are at their birth quite small, (about the size of a half-grown rat;) some that we saw in Texas were not more than two days old and were kept in a barrel. They uttered a plaintive cry not unlike the wail of an infant.

The Raccoon usually produces from four to six young at a time, which are generally brought forth early in May, although the period of their littering varies in different latitudes.

When the Indian corn is ripening, the Raccoons invade the fields to feast on the rich milky grain, as we have just stated, and as the stalks are too weak to bear the weight of these marauders, they generally break them down with their fore-paws, tear off the husks from the ears, and then munch them at their leisure. During this inviting season, the Raccoon is not the only trespasser on the corn fields, but various animals are attracted thither to receive their portion, and even the merry school-boy shares the feast with them, at the risk of paying for his indulgence by incurring the necessity of a physician's prescription the next day. The havoc committed in the Western States by squirrels and other animals is almost incalculable, and no vigilance of the farmer can guard against the depredations of these hungry intruders, which extend from farm to farm, and even penetrate to those embosomed in the forests, where settlements are few and far between.

The Raccoon is not strictly a nocturnal animal; and although it generally visits the corn fields at night, sometimes feeds on the green corn during the day; we have seen it thus employed during the heat of summer, and it will occasionally enter a poultry house at mid-day, and destroy many of the feathered inhabitants, contenting itself with the head and blood of the fowls it kills.

The nest or lair of the Raccoon is usually made in the hollow of some broken branch of a tree. When tamed, these animals are seldom induced to lie or sleep on a layer of straw.

There exists a species of oyster in the Southern States, of inferior quality, which bears the name of Raccoon Oyster: it lies imbedded in masses in the shallow waters of the rivers. These oysters are covered by high tides, but are exposed at low water. On these the Raccoons are fond of feeding, and we have on several occasions seen them on the oyster banks. We have, however, never had an opportunity of ascertaining by personal observation the accuracy of a statement which we have frequently heard made with great confidence, viz., that the Raccoon, at low tide, in endeavouring to extricate these oysters from the shell, is occasionally caught by the foot in consequence of the closing of the valve of the shell fish, when numbers of these being clustered and imbedded together, the Raccoon cannot drag them from their bed, and the returning tide drowns him.

The Naturalist has many difficulties to encounter when inquiring into facts connected with his pursuit: every one acquainted with the habits of even our common species must know that the information gained from most of those who reside near their localities, from their want of particular observation, is generally very limited, and probably the most interesting knowledge gained by such queries would be the result of a comparison of the accounts given at different places. From the Alleghany Mountains, the swamps of Louisiana, and the marshes of Carolina, we have received nearly the same history of the cunning manœuvres and sly tricks of the Raccoon in procuring food.

We add the following notes on a Raccoon kept for a considerable time in a tame state, or partially domesticated:

When it first came into our possession it was about one-third grown. By kind treatment it soon became very docile, but from its well known mischievous propensities we always kept it chained.

It was truly omnivorous, never refusing any thing eatable; vegetable or animal, cooked or uncooked, all was devoured with equal avidity. Of some articles, however, it seemed particularly fond, as sugar, honey, chestnuts, fish and poultry. The animal would become almost frantic when either of the two first was placed near it, but beyond its reach. No means would be left untried to obtain the dainty morsel. It would rush forward as far as the chain permitted, and stretch out a fore-paw toward the object of its wishes to its utmost extent, which failing to reach it, the other was extended; again disappointed, the hind limbs were tried in succession, by which there was a nearer approach to the food, on account of the animal being chained by the neck.

On being offered food when hungry, or roused up suddenly from any cause, or when in active play, the eye was of a lustrous green, changing apparently the whole countenance.

It had a strong propensity to roll food and other things under its paws; segars in particular, especially when lighted. We have observed a similar propensity in young bears.

On placing a pail of water within its reach, it ran to it, and after drinking would examine the contents to the bottom with the fore-paws, seemingly expecting to find some fish or frog. If any thing was found it was speedily brought to the surface and scrutinized. We have seen it throw chips, bits of china and pebbles, &c., into the pail, and then fish them out for amusement, but never saw it put a particle of its food in to soak, except in a few instances when it threw in hard corn, but we do not think it was for this purpose. After playing for a short time in the water it would commonly urinate in it and then upset the pail.

We gave it a fish weighing two pounds. The Raccoon turned it in all directions in search of a convenient point of attack. The mouth, nose, fins, vent, &c., were tried. At length an opening was made at the vent, into which a paw was deeply inserted; the intestines were withdrawn and eaten with avidity. At the same time an attempt was made to insert the other paw into the mouth of the fish to meet its fellow. This disposition to use the paws in concert was shown in almost every action, sometimes in a very ludicrous manner. On giving the animal a jug, one paw would be inserted in the aperture, and a hundred twists and turns would be made to join its fellow on the outside.

After devouring as much of the fish as it wished, it placed the paws on the remainder, and lay down to doze until hunger returned, watching the favourite food, and growling at any animal which happened to pass near it. By degrees this propensity to defend its food passed off, and it would allow the dog or fox to partake of it freely. We placed a half-grown fox within its reach: the Raccoon instantly grasped it with its legs and paws, and commenced a close examination. It thrust its pointed nose in the ear of the fox to the very bottom, smelling and snuffing as if determined to find out the nature of the animal. During this time it showed no disposition to injure the fox.

The Raccoon can scent an object for some distance with accuracy. We suffered ours to go loose on one occasion, when it made directly for some small marmots confined in a cage in another room.

Our pet Raccoon, whose habits we are relating, evinced a singular propensity to listen to things at a distance, however many persons were around him, even though he might be at the moment eating a frog, of which food he was very fond. He would apparently hear some distant noise, then raise his head and continue listening, seeming every moment more absorbed ; at last he would suddenly run and hide himself in his burrow. This seems to be connected with some instinct of the animal in his wild state, probably whilst sitting on a tree sunning himself, when he is in the habit of listening to hear the approach of an enemy, and then hurrying to his hole in the tree.

Enjoying the hospitality of a friend one night at his plantation, the conversation turned on the habits of animals: and in speaking of the Raccoon he mentioned that it fed on birds and rabbits generally, but in winter robbed the poultry houses. The negroes on his plantation he said kept good dogs, and relied on them for hunting the Raccoon.

Whenever a Raccoon was about to attack the poultry house, the dogs scenting him give a shrill cry, which is the signal for his owner to commence the hunt. He comes out armed with an axe, with a companion or two, resolved on a Raccoon hunt. The dog soon gives chase, with such rapidity that the Raccoon, hard pressed, takes to a tree. The dog, close at his heels, changes his whining cry while running to a shrill short sharp bark. If the tree is small or has limbs near the ground so that it can be easily ascended, the eager hunters climb up after the "coon." He perceives his danger, endeavours to avoid his pursuers by ascending to the farthest topmost branch, or the extremity of a limb ; but all his efforts are in vain, his relentless pursuers shake the limb, until he is compelled to let go his hold, and he comes toppling heavily to the ground, and is instantly seized by the dogs. It frequently happens, however, that the trees are tall and destitute of lower branches, so that they cannot be climbed without the risk of of life or limb. The negroes survey for a few moments in the bright moonlight the tall and formidable tree that shelters the coon, grumble a little at the beast for not having saved them trouble by mounting an easier tree, and then the ringing of their axes resounds through the still woods, awakening echoes of the solitude previously disturbed only by the hooting of the owl, or the impatient barking of the dogs. In half an hour the tree is brought to the ground and with it the Raccoon, stunned by the fall ; his foes give him no time to define his position, and after a short and bloody contest with the dogs, he is despatched, and the sable hunters remunerated,—for his skin they will sell to the hatters in the nearest town, and his flesh they will hang up in a tree to freeze and furnish them with many a savoury meal.

The greatest number of Raccoons, however, are killed by log-traps set with a figure of 4 trigger, and baited with a bird or squirrel, an ear of corn, or a fish: either the appetite or curiosity of these animals will entice them into a trap or entangle them in a snare.

Another mode of destroying this species is by fire-hunting, which requires good shooting, as the animal only shows one eye from behind the branch of a tree, which reflecting the light of the fire-hunter's torch, shines like a ball of phosphorus, and is generally knocked out at twenty-five or thirty yards by a good marksman.

The Raccoon, like the bear, hibernates for several months during winter in the latitude of New York, and only occasionally and in a warm day leaves its retreat, which is found in the hollow of some large tree. We once, however, tracked in deep snow the footsteps of a pair of this species in the northern parts of New York, and obtained them by having the tree in which they lay concealed cut down. They had made a circle in company of about a mile, and then returned to their winter domicile.

ARTICLE XLII.—*On the Metamorphoses of Insects.*

(From Kirby and Spence's Introduction to Entomology.)

METAMORPHOSES OF INSECTS.

Were a Naturalist to announce to the world the discovery of an animal which for the first five years of its life existed in the form of a serpent, which then penetrating into the earth, and weaving a shroud of pure silk of the finest texture, contracted itself within this covering into a body without external mouth or limbs, and resembling, more than anything else, an Egyptian mummy, and which, lastly, after remaining in this state without food and without motion for three years longer, should at the end of that period burst its silken cerements, struggle through its earthy covering, and start into day a winged bird,—what think you would be the sensation excited by this strange piece of intelligence? After the first doubt of its truth were dispelled, what astonishment would succeed! Amongst the learned, what surmises!—what investigations! Amongst the vulgar, what eager curiosity and amazement! All would be interested in the history of such an unheard-of phenomenon; even the most torpid would flock to the sight of such a prodigy.

But, you ask, "To what do all these improbable suppositions tend?" Simply to rouse your attention to the *metamorphoses* of the insect world, almost as strange and surprising, to which I am now about to direct your view,—miracles which, though scarcely surpassed in singularity by all that poets have feigned, and though actually wrought every day beneath our eyes, are, because of their commonness, and the minuteness of the objects, unheeded alike by the ignorant and the learned.

The butterfly which amuses you with his aërial excursions, one while extracting nectar from the tube of the honeysuckle, and then the very image of fickleness, flying to a rose as if to contrast the hue of its wings with that of the flower on which it reposes, did not come into the world as you now behold it. At its first exclusion from the egg, and for some months of its existence afterwards, it was a worm-like caterpillar, crawling upon sixteen short legs, greedily devouring leaves with two jaws, and seeing by means of twelve eyes so minute as to be nearly imperceptible without the aid of a microscope. You now view it furnished with wings capable of rapid and extensive flights; of its sixteen feet ten have disappeared, and the remaining six are in most respects wholly unlike those to which they have succeeded; its jaws have vanished, and are replaced by a curled-up proboscis suited only for sipping liquid sweets; the form of its head is entirely changed,—two long horns project from its upper surface; and instead of twelve invisible eyes, you behold two very large, and composed of at least seventeen thousand convex lenses, each supposed to be a distinct and effective eye!

Were you to push your examination further, and by dissection to compare the internal conformation of the caterpillar with that of the butterfly, you would witness changes even more extraordinary. In the former you would find some thousands of muscles, which in the latter are replaced by others of a form and structure entirely different. Nearly the whole body of the caterpillar is occupied by a capacious stomach. In the butterfly it has become converted into an almost imperceptible thread-like viscus; and the abdomen is now filled by two large packets of eggs, or other organs not visible in the first state. In the former, two spirally-convoluted tubes were filled with a silky gum; in the latter, both tubes and silk have almost totally vanished; and changes equally great have taken place in the economy and structure of the nerves and other organs.

What a surprising transformation! Nor was this all. The change from one form to the other was not direct. An intermediate state not less singular intervened. After casting its skin, even to its very jaws, several times, and attaining its full growth, the caterpillar attached itself to a leaf by a silken girth. Its body greatly contracted: its skin once more split asunder, and disclosed an oviform mass, without exterior mouth, eyes, or limbs, and exhibiting no other symptom of life than a slight motion when touched. In this state of death-like torpor, and without tasting food, the insect existed for several months, until at length the tomb burst, and out of a case not more than an inch long, and a quarter of an inch in diameter, proceeded the butterfly before you, which covers a surface of nearly four inches square.

Almost every insect which you see has undergone a transformation as singular and surprising, though varied in many of its circumstances. That active little fly, now an unbidden guest at your table, * whose delicate palate selects your chociest viands one while extending his proboscis to the margin of a drop of wine, and then gaily flying to take a more solid repast from a pear or a peach; now gamboling with his comrades in the air, now gracefully currying his furled wings with his taper feet, was but the other day a disgusting grub, without wings, without legs, without eyes, wallowing, well pleased, in the midst of a mass of excrement.

The "grey-coated gnat," whose humming salutation, while she makes her airy circles about your bed, gives terrific warning of the sanguinary operation in which she is ready to engage, was a few hours ago the inhabitant of a stagnant pool, more in shape like a fish than an insect. Then to have been taken out of the water would have been speedily fatal; now it could as little exist in any other element than air. Then it breathed through its tail; now through openings in its sides. Its shapeless head, in that period

* "Cœnis etiam non vocatus ut Musca advolo." Aristophon in *Pythagorista* apud Athenæum. (Mouffet, 56.)

of its existence, is now changed for one adorned with elegantly tufted antennæ, and furnished, instead of jaws, with an apparatus more artfully constructed than the cupping-glasses of the phlebotomist,—an apparatus which, at the same time that it strikes in the lancets, composes a tube for pumping up the flowing blood.

The "shard-born beetle," whose "sullen horn," as he directs his "droning flight" close past your ears in your evening walk, calling up in poetic association the lines in which he has been alluded to by Shakspeare, Collins, and Gray, was not in his infancy an inhabitant of air, the first period of his life being spent in gloomy solitude, as a grub, under the surface of the earth. The shapeless maggot which you scarcely fail to meet with in some one of every handful of nuts you crack, would not always have grovelled in that humble state. If your unlucky intrusion upon its vaulted dwelling had not left it to perish in the wide world, it would have continued to reside there until its full growth had been attained. Then it would have gnawed itself an opening, and, having entered the earth, and passed a few months in a state of inaction, would at length have emerged an elegant beetle, furnished with a slender and very long ebony beak, two wings, and two wing-cases, ornamented with yellow bands, six feet, and in every respect unlike the worm from which it proceeded.

That bee——but it is needless to multiply instances, a sufficient number has been adduced to show that the apparently extravagant supposition with which I set out may be paralleled in the insect world; and that the metamorphoses of its inhabitants are scarcely less astonishing than would be the transformation of a serpent into an eagle.

These changes I do not purpose explaining minutely in this place: they will be adverted to more fully in subsequent letters. Here I mean merely to give you such a general view of the subject as shall impress you with its claims to attention, and such an explanation of the states through which insects pass, and of the different terms made use of to designate them in each, as shall enable you to comprehend the frequent allusions which must be made to them in our future correspondence.

The states through which insects pass are four: the *egg*, the *larva*, the *pupa*, and the *imago*.

The first of these need not be here adverted to. In the *second*, or immediately after the exclusion from the egg, they are soft, without wings, and in shape usually somewhat like worms. This Linné called the *larva* state, and an insect when in it a *larva*, adopting a Latin word signifying a *mask*, because he considered the real insect while under this form to be as it were masked. In the English language we have no common term that applies to the second state of all insects, though we have several for that of different tribes. Thus we call the coloured and often hairy larvæ of butterflies and moths *caterpillars;* the white and more compact larvæ of flies, many beetles, &c., *grubs* or *maggots;** and the depressed larvæ of many other insects *worms.* The two former terms I shall sometimes use in a similar sense, rejecting the last, which ought to be confined to true *vermes;* but I shall more commonly adopt Linné's term, and call insects in their second state *larvæ.*

In this period of their life, during which they eat voraciously and cast their skin several times, insects live a shorter or longer period, some only a few days or weeks, others several months or years. They then cease eating; fix themselves in a secure place; their skin separates once more, and discloses an oblong body, and they have now attained the *third* state of their existence.

From the swathed appearance of most insects in this state, in which they do not badly resemble in miniature a child trussed up like a mummy in swaddling clothes, according to the barbarous fashion once prevalent here, and still retained in many parts of the Continent, Linné has called it the *pupa* state, and an insect when under this form a *pupa*,—terms which will be here adopted in the same sense. In this state most insects eat no food; are incapable of locomotion; and, if opened, seem filled with a watery fluid, in which no distinct organs can be traced. Externally, however, the shape of the pupæ of different tribes varies considerably, and different names have been applied to them.

Those of the beetle and bee tribes are covered with a membraneous skin, enclosing in separate and distinct sheaths the external organs, as the antennæ, legs, and wings, which are conse-

* *Gentils*, or *gentles*, is a synonymous word employed by our old authors, but is now obsolete, except with anglers. Thus Tusser, in a passage pointed out to me by Sir Joseph Banks:—

"Reward not thy sheep when ye take of his cote
With twitches and patches as brode as a grote;
Let not such ungentlenesse happen to thine,
Least fly with her *gentils* do make it to pine."

quently not closely applied to the body, but have their form for the most part clearly distinguishable. To these Aristotle originally gave the name of *nymphæ*,* which was continued by Swammerdam and other authors prior to Linné (who calls them *incomplete* pupæ,) and has been adopted by many English writers on insects.

Butterflies, moths, and some of the two-winged tribe, are in their pupa state also enclosed in a similar membraneous envelope; but their legs, antennæ, and wings, are closely folded over the breast and sides; and the whole body enclosed in a common case or covering of a more horny consistence, which admits a much less distinct view of the organs beneath it. As these pupæ are often tinged of a golden colour, they were called from this circumstance *chrysalides* by the Greeks, and *aureliæ* by the Romans, both which terms are in some measure become anglicized; and though not applicable to ungilded pupæ, are now often given to those of all lepidopterous insects.† These by Linné are denominated *obtected* pupæ.

I have said that *most* insects eat no food in the pupa state. This qualification is necessary, because in the metamorphoses of insects, as in all her other operations, nature proceeds by measured steps,

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* *Hist. Anim.* 1. 5. c. 10.

† In explanation of the terms *Lepidopterous*, *Coleoptera*, &c., which will frequently occur in the following pages before coming regularly to definitions, it is necessary here to state that they have reference to the names given by entomologists to the different *orders* or tribes of insects, as under:—

1. *Coleoptera*, consisting of *Beetles*.
2. *Strepsiptera*, ——— of the genera *Xenos* and *Stylops*.
3. *Dermaptera*, ——— of the *Earwigs*.
4. *Orthoptera*, ——— of *Cockroaches, Locusts, Grasshoppers, Crickets, Spectres, Mantes, &c.*
5. *Hemiptera*, consisting of *Bugs, Cicadæ, Water-scorpions, Water-boatmen, Plant-lice, Cochineal Insects, &c.*
6. *Trichoptera*, consisting of the *flies* produced by the various species of *Case-worms*, *Phryganea*, L.
7. *Lepidoptera*, consisting of *Butterflies*, *Hawkmoths*, and *Moths*.
8. *Neuroptera*, consisting of *Dragon-flies*, *Ant-lions*, *Ephemeræ*, *&c.*
9. *Hymenoptera*, consisting of *Bees*, *Wasps*, and other insects armed with a *sting* or *ovipositor*, and its *valves*.
10. *Diptera*, consisting of *Flies*, *Gnats*, and other *two-winged* insects.
11. *Aphaniptera*, consisting of the *Flea* tribe.
12. *Aptera*, ——— of *Mites, Lice, &c.*

and a very considerable number (the tribe of locusts, cockroaches, bugs, spiders, &c.,) not only greatly resemble the perfect insect in form, but are equally capable with it of eating and moving. As these insects, however, cast their skins at stated periods, and undergo changes, though slight, in their external and internal conformation, they are regarded also as being subject to metamorphoses. These pupæ may be subdivided into two classes: first, those comprised, with some exceptions, under the Linnean *Aptera*, which in almost every respect resemble the perfect insect, and were called by Linné *complete* pupæ ; and, secondly, those of the Linnean order *Hemiptera*, which resemble the perfect insect, except in having only the rudiments of wings, and to which the name of *semi-complete* pupæ was applied by Linné, and that of *semi-nymphs* by some other authors. There is still a fifth kind of pupæ, which are not, as in other instances, excluded from the skin of the larva, but remain concealed under it, and were hence called by Linné *coarctate* pupæ. These, which are peculiar to flies and some other dipterous genera, may be termed *cased-nymphs*.

When, therefore, we employ the term *pupa*, we refer indifferently to the third state of any insect, the particular order being indicated by the context, or an explanatory epithet. The terms *chrysalis* (dropping *aurelia*, which is superfluous,) *nymph*, *semi-nymph*, and *cased-nymph*, on the other hand definitely pointing out the particular sort of pupa meant: just as in Botany, the common term *pericarp* applies to all seed-vessels, the several kinds being designated by the names of capsule, silicle, &c.

The envelope of *cased-nymphs*, which is formed of the skin of the larva, considerably altered in form and texture, may be conveniently called the *puparium ;* but to the artificial coverings of different kinds, whether of silk, wool, or earth, &c., which many insects of the other orders fabricate for themselves previously to assuming the pupa state, and which have been called by different writers, *pods*, *cods*, *husks*, and *beans*, I shall continue the more definite French term *cocon*, anglicized into *cocoon*.

After remaining a shorter or longer period, some species only a few hours, others months, others one or more years, in the pupa state, the enclosed insect, now become mature in all its parts, bursts the case which enclosed it, quits the pupa, and enters upon the fourth and last state.

We now see it (unless it be an apterious species) furnished with wings, capable of propagation, and often under a form altogether different from those which it has previously borne—a perfect beetle, butterfly, or other insect. This Linné termed the *imago* state, and the animal that had attained to it the *imago;* because, having laid aside its *mask*, and cast off its *swaddling bands*, being no longer disguised or confined, or in any respect imperfect, it is now become a true representative or *image* of its species. This state is in general referred to when an insect is spoken of without the restricting terms larva or pupa.

Such being the singularity of the transformation of insects, you will not think the ancients were so wholly unprovided with a show of argument as we are accustomed to consider them, for their belief in the possibility of many of the marvellous metamorphoses which their poets recount. Utterly ignorant as they were of modern physiological discoveries, the conversion of a caterpillar into a butterfly must have been a fact sufficient to put to a nonplus all the sceptical oppugners of such transformations. And however we may smile, in this enlightened age, at the inference drawn not two centuries ago by Sir Theodore Mayerne, the editor of Mouffet's Work on Insects, "that if animals are transmuted so may metals," * it was not, in fact, with his limited knowledge on these subjects, so very preposterous. It is even possible that some of the wonderful tales of the ancients were grafted on the changes which they observed to take place in insects. The death and revivification of the phœnix, from the ashes of which, before attaining his perfect state, arose first a *worm* (*Scolex*,) in many of its particulars resembles what occurs in the metamorphoses of insects. Nor is it very unlikely that the doctrine of the metempsychosis took its rise from the same source. What argument would be thought by those who maintained this doctrine more plausible, in favor of the transmigration of souls, than the seeming revivification of the dead *chrysalis?* What more probable than that its apparent re-assumption of life should be owing to its receiving for tenant the soul of some criminal doomed to animate an insect of similar habits with those which had defiled his human element? †

* Epist. Dedicat.

† "A priest who has drunk wine shall migrate into a moth or fly, feeding on ordure. He who steals the gold of a priest shall pass a thousand times into the bodies of spiders. If a man shall steal honey, he shall be born a great stinging gnat; if oil, an oil-drinking beetle; if salt, a cicada; if a household utensil, an ichneumon fly." *Institute of Menu*, 353.

At the present day, however, the transformations of insects have lost that excess of the marvellous, which might once have furnished arguments for the fictions of the ancients, and the dreams of Paracelsus. We call them metamorphoses and transformations, because these terms are in common use, and are more expressive of the sudden changes that ensue than any new ones. But, strictly, they ought rather to be termed a series of developments. A caterpillar is not, in fact, a simple but a compound animal, containing within it the germ of the future butterfly, enclosed in what will be the case of the pupa, which is itself included in the three or more skins, one over the other, that will successively cover the larva. As this increases in size these parts expand, present themselves, and are in turn thrown off, until at length the perfect insect, which had been concealed in this succession of masks, is displayed in its genuine form. That this is the proper explanation of the phenomenon has been satisfactorily proved by Swammerdam, Malpighi, and other anatomists. The first-mentioned illustrious naturalist discovered, by accurate dissections, not only the skins of the larva and of the pupa encased in each other, but within them the very butterfly itself, with its organs indeed in an almost fluid state, but still perfect in all its parts.* Of this fact you may convince yourself without Swammerdam's skill, by plunging into vinegar or spirit of wine a caterpillar about to assume the pupa state, and letting it remain there a few days for the purpose of giving consistency to its parts; or by boiling it in water for a few minutes. A very rough dissection will then enable you to detect the future butterfly; and you will find that the wings, rolled up into a sort of cord, are lodged between the first and second segment of the caterpillar; that the antennæ and trunk are coiled up in front of the head; and that the legs, however different their form, are actually sheathed in its legs. Malpighi discovered the eggs of the future moth in the chrysalis of a silk-worm only a few days old,† and Reaumur those of another moth (*Hypogymna dispar*) even in the caterpillar, and that seven or eight days before its change into the pupa.‡ A caterpillar, then, may be regarded as a locomotive egg, having for its embryo the included butterfly, which after a

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* Hill's *Swamm.* ii. 24, t. 37. f. 2. 4.

† *De Bombyce* 29.

‡ Reaum. i. 359.

certain period assimilates to itself the animal substances by which it is surrounded; has its organs gradually developed; and at length breaks through the shell which encloses it.

This explanation strips the subject of every thing miraculous, yet by no means reduces it to a simple or uninteresting operation. Our reason is confounded at the reflection that a larva, at first not thicker than a thread, includes the germs of its own triple, or sometimes octuple, teguments; the case of a chrysalis, and of a butterfly, all curiously folded in each other; with an apparatus of vessels for breathing and digesting, of nerves for sensation, and of muscles for moving; and that these various forms of existence will undergo their successive evolutions, by aid of a few leaves received into its stomach. And still less able are we to comprehend how this organ should at one time be capable of digesting leaves, at another only honey; how one while a silky fluid should be secreted, at another none; or how organs at one period essential to the existence of the insect should at another be cast off, and the whole system which supported them vanish.*

Nor does this explanation, though it precludes the idea of that resemblance, in every particular, which, at one time, was thought to obtain between the metamorphosis of insects, especially of the *Lepidoptera* order, and the resurrection of the body, do away that general analogy which cannot fail to strike every one who at all considers the subject. Even Swammerdam, whose observations have proved that the analogy is not so complete as had been imagined, speaking of the metamorphosis of insects, uses these strong words: "This process is formed in so remarkable a manner in butterflies, that we see therein the resurrection painted before our eyes, and exemplified so as to be examined by our hands."† To see, indeed, a caterpillar crawling upon the earth sustained by the most ordinary kinds of food, which, when it has existed a few weeks or months under this humble form, its appointed work being finished, passes into an intermediate state of seeming death, when it is wound up in a kind of shroud and encased in a coffin,

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* Dr. Herold (*Entwickelungs geschichte der Schmetterlinge.*) and other modern physiologists, deny that the germs of the skins of the caterpillar and chrysalis and of the future butterfly exist in the young caterpillar; but, for reasons assigned in detail in another place (vol. iii. edit. 5. pp. 52—62.) the theory of Swammerdam and Bonnet, as above explained, is here preferred.

† Hill's *Swamm.* i. 127. a.

and is most commonly buried under the earth (though sometimes its sepulchre is in the water, and at others in various substances in the air,) and after this creature and others of its tribe have remained their destined time in this death-like state, to behold earth, air, and water give up their several prisoners: to survey them, when, called by the warmth of the solar beam, they burst from their sepulchres, cast off their cerements, from this state of torpid inactivity, come forth, as a bride out of her chamber,—to survey them, I say, arrayed in their nuptial glory, prepared to enjoy a new and more exalted condition of life, in which all their powers are developed, and they are arrived at the perfection of their nature; when no longer confined to the earth they can traverse the fields of air, their food is the nectar of flowers, and love begins his blissful reign;—who that witnesses this interesting scene can help seeing in it a lively representation of man in his threefold state of existence, and more especially of that happy day, when, at the call of the great Son of Righteousness, "all that are in the graves shall come forth; the sea shall give up her dead, and death being swallowed up of life, the nations of the blessed shall live and love to the ages of eternity?"

But although the analogy between the different states of insects and those of the body of man is only general, yet it is much more complete with respect to his soul. He first appears in his frail body—a child of the earth, a crawling worm, his soul being in a course of training and preparation for a more perfect and glorious existence. Its course being finished, it casts of the earthly body, and goes into a hidden state of being in Hades, where it rests from its works, and is prepared for its final consummation. The time for this being arrived, it comes forth clothed with a glorious body, not like its former, though germinating from it, for, though "*it is sown an animal body, it shall be raised a spiritual body,*" endowed with augmented powers, faculties, and privileges commensurate to its new and happy state. And here the parallel holds perfectly between the insect and the man. The butterfly, the representative of the soul, is prepared in the *larva* for its future state of glory; and if it be not destroyed by the ichneumons and other enemies to which it is exposed, symbolical of the vices that destroy the spiritual life of the soul, it will come to its state of repose in the *pupa*, which is its Hades; and at length, when it assumes the *imago*, break forth with new powers and beauty to its final glory and the reign of love. So that in this view of the subject well might the Italian poet exclaim:—

Non v' accorgete voi, che noi siam' vermi,
Nati a formar l' angelica farfalla? *

The Egyptian fable, as it is supposed to be, of Cupid and Psyche, seems built upon this foundation. "Psyche," says an ingenious and learned writer, "means in Greek the human soul; and it means also a butterfly, † of which apparently strange double sense the undoubted reason is that a butterfly was a very ancient symbol of the soul: from the prevalence of this symbol, and the consequent coincidence of the names, it happened that the Greek sculptors frequently represented Psyche as subject to Cupid in the shape of a butterfly; and that even when she appears in their works under the human form, we find her decorated with the light and filmy wings of that gay insect." ‡

The following beautiful little poem falls in so exactly with the subject I have been discussing, that I cannot resist the temptation I feel to copy it for you, especially as I am not aware that it has appeared anywhere but in a newspaper:—

THE BUTTERFLY'S BIRTH-DAY.

BY THE AUTHOR OF "THE BUTTERFLY'S BALL."

The shades of night were scarcely fled;
The air was mild, the winds were still;
And slow the slanting sun-beams spread
O'er wood and lawn, o'er heath and hill:

From fleecy clouds of pearly hue
Had dropt a short but balmy shower,
That hung like gems of morning dew
On every tree and every flower:

And from the blackbird's mellow throat
Was pour'd so loud and long a swell,
As echoed with responsive note
From mountain side and shadow dell.

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* Do you not perceive that we are caterpillars, born to form the angelic butterfly?

† It is worthy of remark that in the north and west of England the moths that fly into candles are called *saules* (souls,) perhaps from the old notion that the souls of the dead fly about at night in search of light. For the same reason, probably, the common people in Germany call them *ghosts* (geistchen.)

‡ Nare's *Essays*, i. 101, 102.

When bursting forth to life and light,
The offspring of enraptured May,
The Butterfly, on pinions bright,
Launch'd in full splendour on the day.

Unconscious of a mother's care,
No infant wretchedness she knew;
But as she felt the vernal air,
At once to full perfection grew.

Her slender form, ethereal light,
Her velvet-textured wings unfold;
With all the rainbow's colours bright,
And dropt with spots of burnish'd gold.

Trembling with joy awhile she stood,
And felt the sun's enlivening ray;
Drank from the skies the vital flood,
And wondered at her plumage gay!

And balanced oft her broidered wings,
Through fields of air prepared to sail:
Then on her vent'rous journey springs,
And floats along the rising gale.

Go, child of pleasure, range the fields,
Taste all the joys that spring can give,
Partake what bounteous summer yields,
And live whilst yet, tis time to live.

Go sip the rose's fragrant dew,
The lily's honeyed cup explore,
From flower to flower the search renew,
And rifle all the woodbine's store:

And let me trace thy vagrant flight,
Thy moments too of short repose,
And mark thee then with fresh delight
Thy golden pinions ope and close.

But hark! whilst thus I musing stand
Pours on the gale an airy note,
And breathing from a viewless band,
Soft silvery tones around me float!

— They cease—but still a voice I hear,
A wisper'd voice of hope and joy,
"Thy hour of rest approaches near,
"Prepare thee, mortal!—thou must die!

"Yet start not!—on thy closing eyes
"Another day shall still unfold,
"A sun of milder radiance rise,
"A happier age of joys untold.

"Shall the poor worm that shocks thy sight,
"The humblest form in nature's train,
"Thus rise in new-born lustre bright,
"And yet the emblem teach in vain?

"Ah! where were once her golden eyes,
"Her glittering wings of purple pride?
"Concealed beneath a rude disguise,
"A shapeless mass to earth allied.

"Like thee the hapless reptile lived,
"Like thee he toil'd like thee he spun,
"Like thine his closing hour arrived,
"His labour ceased, his web was done.

"And shalt thou, number'd with the dead,
"No happier state of being know?
"And shall no future morrow shed
"On thee a beam of brighter glow?

"Is this the bound of power divine,
"To animate an insect frame?
"Or shall not He who moulded thine
"Wake at his will the vital flame.

"Go, mortal! in thy reptile state,
"Enough to know to thee is given;
"Go, and the joyful truth relate;
"Frail child of earth! high heir of heaven!"

A question here naturally presents itself—Why are insects subject to these changes? For what end is it that, instead of preserving, like other animals,* the same general form from

* A few verterbrate animals, viz., frogs, toads, and newts, undergo metamorphoses in some respects analogous to those of insects; their first form as tadpoles being very different from that which they afterwards assume. These reptiles, too, as well as snakes, cast their skin by an operation somewhat similar to that in *larvæ*. There is nothing, however, in their metamorphoses at all resembling the *pupa* state in insects. (See, however, Von Baer's article on the Analogies of the Transformations of Insects and the Higher Animals in the *Annales des Sciences Nat.*) According to Mr. J. V. Thompson, both the common barnacles and many *crustacea* undergo metamorphoses, but to what extent these changes take place in the latter does not seem clearly ascertained.

infancy to old age, they appear at one period under a shape so different from that which they finally assume; and why should they pass through an intermediate state of torpidity so extraordinary? I can only answer that such is the will of the Creator, who doubtless had the wisest ends in view, although we are incompetent satisfactorily to discover them. Yet one reason for this conformation may be hazarded. A very important part assigned to insects in the economy of nature, as I shall hereafter show, is that of speedily removing superabundant and decaying animal and vegetable matter. For such agents an insatiable voracity is an indispensible qualification, and not less so unusual powers of multiplication. But these faculties are in a great degree incompatible. An insect occupied in the work of reproduction could not continue its voracious feeding. Its life, therefore, after leaving the egg, is divided into three stages. In the first, as *larva*, it is in a state of sterility; its sole object is the satisfying its insatiable hunger; and, for digesting the masses of food which it consumes, its intestines are almost all stomach. This is usually by much the longest period of its existence. Having now laid up a store of materials for the development of the future perfect insect, it becomes a *pupa;* and during this inactive period the important process slowly proceeds, uninterrupted by the calls of appetite. At length the perfect insect is disclosed. It now often requires no food at all; and scarcely ever more than a very small quantity; for the reception of which its stomach has been contracted, in some instances, to a tenth of its former bulk. Its almost sole object is now the multiplication of its kind, from which it is diverted by no other propensity; and this important duty being performed, the end of its existence has been answered, and it expires.

It must be confessed that some objections might be thrown out against this hypothesis, yet I think none that would not admit of a plausible answer. To these it is foreign to my purpose now to attend, and I shall conclude this letter by pointing out to you the variety of new relations which this arrangement introduces into nature. One individual unites in itself, in fact, three species, whose modes of existence are often as different as those of the most distantly related animals of other tribes. The same insect often lives successively in three or four worlds. It is an inhabitant of the water during one period, of the earth during another and of the air during a third; and fitted for its various abodes by new organs and instruments, and a new form in each. Think (to use an illustration of Bonnet) but of the cocoon of the silk-worm! How many hands, how many machines does not this little ball put in motion! Of what riches should we not have been deprived, if the moth of the silk-worm had been born a moth, without having been previously a caterpillar! The domestic economy of a large portion of mankind would have been formed on a plan altogether different from that which now prevails.

I am, &c.

ARTICLE XLIII.—*On the Classification of Fishes. With particular reference to the Fishes of Canada.*—By Frank Forelle.

Fishes belong to the first department of the animal kingdom, the Vertebrata, having an internal skeleton, with a back-bone for its axis, yet occupying the lowest position in that department, as will be seen by referring to the first number of this Magazine. They have red blood, not warm like that of the animals comprised in the first and second classes of this department, the mammals and birds, but cold like that of the reptiles. They are destitute of lungs, and on this account they cannot live in the air, for their blood is oxygenized through the medium of water passing between their branchiæ or gills. These are for the most part composed of thin plates or laminæ, fixed on arches, called the branchial arches, and are covered with countless minute blood vessels, which are so arranged as to present a large surface to the water, which in most fishes is taken in at the mouth and expelled at the aperture under the gill covers, so as to keep a constant current passing through the gills to renew the supply of oxygen.

Their heart is unilocular, that is, it is not divided into two auricles and two ventricles, as in mammals and birds, nor yet into two auricles and one ventricle as in reptiles, but has only one auricle and one ventricle. The blood in its circulation passes from the auricle into the ventricle and from thence into the gills, where it is brought into close proximity to the air diffused through the water, and having been thus aërated is distributed by arteries through the system, and returned by the veins to the auricle.

Fishes are variously covered: some have imbricate scales, as the Perch; some have bony shields or plates, as the Sturgeon; some are covered with a rough shagreen like skin, as the Shark; and others only by a smooth mucous skin, as some of the Catfishes. The scales are of two kinds: one kind is composed of a substance resembling horn; the other is harder and quite enamel-like in its appearance, and may be seen on the Garfishes. For the most part fishes are oviparous, reproducing by eggs, and these usually are fecundated after they are laid; but the distinction between oviparous and viviparous animals has lost its importance since modern science has shewn that there is a period in the existence of every animal when it was enclosed in an egg. The limbs of fishes are adapted in form to suit the element in which they move, so that instead of arms and legs they have fins. Those on the back are called dorsal fins; the one that forms the tail is the caudal fin; the fins on the under side, which are placed vertically, are called anal fins; the remainder are arranged in pairs, one fin on each side: the pair nearest the head are called pectoral fins; the other pair, usually placed behind the pectorals, though sometimes found just beneath them, are the ventral fins. The number of dorsal and of anal fins varies in different species, but there is never more than one caudal, nor more than one pair of pectorals or of ventrals; but in some species the ventrals are absent, and in others the ventrals and pectorals are both wanting. The fins are a membrane, usually thin, supported and extended by rays. Some of these rays are composed of a single continuous bony spine, hard and often sharply pointed, and these are called spinous rays; others are formed of numerous small bones articulated upon each other, often branching out towards their extremities into several filaments, which, from their structure, are soft and flexible, and are called indifferently soft rays, flexible rays or articulated rays. Some fins are composed part of spinous rays and part soft rays, like the dorsal fin of the Rock Bass, *Centrarchus æneus;* some are wholly spine-rayed, like the first dorsal of the American Sandre, *Lucioperca Americana;* and some are wholly soft-rayed, like the fins of the common Pickerel, *Esox reticulatus*

The teeth are usually a simple spine, very acute, and curving inward at the tip, and are arranged sometimes in single rows, sometimes in double and sometimes in cards. They are to be met with on the tongue, the vomer, the palatal bones, the maxillaries, intermaxillaries, and on the pharangeal bones, and their presence or absence is of much importance often in determining the species. The vomer is the bone in the centre of the roof of the mouth; the palatal bones are those lying on each side of the vomer, and forming the greater portion of the roof of the mouth; the intermaxillaries usually form the greater part of the upper jaw, the maxillaries lying behind them, and articulating with the vomer, though in some fishes, as the Salmones, the intermaxillaries and maxillaries form one continuous arch; the pharyngeal bones are located in the pharynx, the cavity leading to the œsophagus or gullet.

It is thought that the senses of taste and of touch are but imperfectly developed, and that those of sight and smell are much more acute, while their power of hearing has been wholly doubted, though it is now generally believed that they can hear. They certainly possess some sense which enables them to find the bait in the darkness of night, many feet down, in waters that break and boil like a caldron, when the eye of man could barely discern the white crests on the rapids.

There is a line more or less distinct along each side of the body, extending from the gill-covers to the tail, known as the lateral line. It is formed by a series of tubes, whose office is to pour out a slimy secretion, which covers and lubricates the body of the fish. The gill-covers are usually composed of four bones: the anterior one is called the pre-opercle; the next and usually the largest bone is the opercle; at the posterior edge of the opercle is a bone called the sub-opercle, and at the inferior edge of the pre-opercle is usually a small bone called the inter-opercle.

Most fishes are carnivorous, preying upon worms, insects and smaller fishes, even those of their own species; a few subsist mainly upon vegetable substances.

Of the several systems of classification that have been propounded, that of Cuvier has been the most extensively employed, and though more extensive acquaintance with this branch of Natural History proves the system to be somewhat too artificial, yet it is indispensable that the student understand it thoroughly. Observing that some fishes had a bony skeleton of fibrous texture, and that others had a cartilaginous skeleton without fibres, Cuvier divided all fishes into two great series, and called one of them the Osseous Series and the other the Cartilaginous Series. The osseous or bony series comprises by far the greater number, and this series he subdivided into three sections, which are based chiefly upon the differences observable in the construction of the gills and jaws. The first section is called PECTINIBRANCHII, from *pecten*, a comb, and *branchiæ*, gills, the gills being arranged in comb-like ridges; the second, PLECTOGNATHI, from *pleko*, to connect, and *gnathos*, a jaw, the maxillary and intermaxillary bones being connected or soldered together on the sides, to form the upper jaw; the third, LOPHOBRANCHII, from *lophos*, a tuft, and *branchiæ*, gills, the gills being arranged in small round tufts. The first section he again divided into three orders, founded upon differences in their fins. Those which have spinous rays in the dorsal fins he placed in the first order, which he called ACANTHOPTERYGII, from *acanthos*, a spine, and *pteryx*, a wing or fin. Of this order are the Yellow Perch, *Perca flavescens*, the common Pondfish, *Pomotis vulgaris*, the Black Bass, *Grystes nigricans*, &c. In the second order he arranged those which have only soft rays, excepting sometimes the first ray of the dorsal and pectoral fins, and called this order MALACOPTERYGII, from *malacos*, soft, and *pteryx*, a fin. Of this order he made two divisions, according to the position of the ventral fins: those having their ventrals attached to the walls of the abdomen, he called ABDOMINAL MALACOPTERYGII; those having them placed very near to the pectorals, with the bones supporting them, attached to the bones of the shoulder, he called SUBBRACHIAL MALACOPTERYGII. The abdominal soft-rayed fishes can be studied in the common Pickerel, *Esox reticulatus*, the Brook Trout, *Salmo fontinalis*, the common Catfish, *Pimelodus catus*, &c. In the subbrachial division will be found the American Codfish, *Morrhua Americana*, the Halibut, *Hippoglossus vulgaris*, &c. Those which had no ventral fins he formed into a third order, which he denominated APODAL, from *a*, negative, and *pous*, a foot. This order the student will notice in the common Eel, *Anguilla tenuirostris*.

The second section, PLECTOGNATHI, embraces the Balloonfishes, Puffers, Filefishes, &c. The third section, LOPHOBRANCHII, contains the Pipefishes, &c; neither of them, however, so far as I am informed, have any representatives in our waters.

Cuvier divided the cartilaginous fishes also into three orders: the first order he called, ELEUTHEROPOMI, from *eleutheros*, free, and *poma*, a cover, in which he placed those fishes of this series which have free pectinated gills, with an aperture on each side, covered by an opercle; this order may be studied in the Sturgeons, ACIPENSERIDÆ. The second order embraces those which have the gills fixed by their external edges, with five small external openings on each side, but without any gill-cover, and is called PLAGIOSTOMI, from *plagios*, curved, and *stoma*, a mouth; in this order is found the Sharks, SQUALIDÆ, and Rays, RAIIDÆ.

In the third order is placed those having purse-shaped gills, fixed and opening outwards, with a circular mouth, and is called Cyclostomi, from *kuklos*, a circle, and *stoma*, a mouth; this order may be studied in the Lampreys, Petromyzontidæ.

The different orders are divided into families; the families are again divided into genera, and each genus comprises one or more species. The order Acanthopterygii, or spine-rayed fishes, is divided now into perhaps twenty different families; of these the first is the Percidæ, the Perch family, so named because the Perch may be considered as the type of all the fishes included in this family. This family includes a large number of genera, several of which may be met with in our waters. Of these perhaps the genus Perca is the most widely disseminated in our lakes and streams, though it has but one species in America, the Yellow Perch, *Perca flavescens*. Dekay, in the Natural History of New York, has described five different species, relying on the authority of Cuvier; but Agassiz says that the differences upon which they are based are not constant characters, and that after comparing specimens from Sault St. Mary, Lake Huron, the waters of Massachusetts, New York and Pennsylvania, he has seen the same variations occuring in each of the supposed species, and is satisfied of their specific identity. The Yellow Perch has two dorsal fins, barely separate from each other, about three-tenths of an inch; the first has thirteen spinous rays, the second has the first two spinous, and fifteen soft rays. There are fifteen soft rays in the pectoral, and one spinous and five soft rays in the ventrals; the anal fin has two spinous and eight soft rays, and the caudal seventeen soft rays. The number of the fin rays is often stated in scientific works in a brief formula, and those of the Perch would be given thus, D. 13, II, 16; P.15; V. I, 5; A. II, 8; C. 17. The rays which support the membrane lying beneath the gill-covers are called the Branchiostegous rays, and in the Yellow Perch are seven in number. On the side the color is yellow, though varying much in brilliancy in different waters, with several dark vertical bands across the back, extending quite on to the sides; the pectoral, ventral and anal fins are a bright orange, the dorsals and caudal greenish; the iris is golden yellow, and the pupil of the eye is black.

This handsome fish is also very hardy, and can be easily transported from one pond to another, while the sharp spines of his dorsal fin serve as a good defence against the attacks of those fresh water sharks, the Pickerels. He bites boldly at the worm or the minnow, and with light tackle affords considerable sport for a few minutes, for he pulls strong and struggles vigorously while his strength lasts. Nor is he by any means to be despised by the inland angler, for though not often exceeding a pound in weight, nicely broiled or fried he is very acceptable.

Also the genus Labrax has a representative, in Lakes Erie and Ontario, in the White Lake Bass, *Labrax albidus.* This genus is distinguished by having a disk or bands of teeth on the tongue, the dorsal fins distant and separate, and teeth on both jaws, and on the vomer and the palatine bones. The White Lake Bass seldom exceeds fifteen inches in length, is of a bluish white on the back, white on the sides, with a few narrow dusky stripes running parallel with the lateral line, and white on the belly. The fins have a bluish tinge; iris white, mixed with a little brown; pupil black; the fin rays are D. IX, I, 13; P. 17; V. I. 5; A. III, 12; C. 17.

It is probable that another species of this genus, the Striped Sea Bass, *Labrax lineatus,* ascends the Saint Lawrence to spawn.

The genus Lucioperca is also found in nearly all our waters. Agassiz is of the opinion that there is but one American species of this genus, and that the *Lucioperca Canadensis* of H. Smith and the *L. grisea* of Dekay are nothing more than the *L. Americana.* This fish, the Lucioperca Americana, has been very generally called Pike, Yellow Pike, or Pickerel, although it is not a Pickerel at all, not even belonging to the same order as the Pickerels. Dekay has translated the Latin name, and calls it Pikeperch, but the analogous European fish is called *Sandre,* and this might with great propriety be called the *American Sandre.*

The Canadian student will also find the genus Grystes: it is nobly reprensented by the Black Bass, *Grystes nigricans;* also the genus Centrarchus, of which we have but one species, the Rock Bass, *Centrarchus æneus;* and the genus Pomotis, which he can study in the common Pondfish, *Pomotis vulgaris.*

The fourth family of this order, the SCIENIDÆ, so called from the Maigres, *Scienæ,* being the type, is represented in Canadian waters by the genus CORVINA, of which there are two species, the Malasheganay, *Corvina Richardsonii,* found only in the lakes above Niagara Falls, and the Lake Sheepshead, *Corvina oscula,* which is as abundant below the Falls as it is above. The first is an excellent fish, and always considered a prize; the second is tough and tasteless, a pest to the angler for Black Bass, for running in company with the latter, he often takes the bait designed for his betters.

The family SCOMBRIDÆ, of which the Mackerel is the type, contains the Spring Mackerel, *Scomber vernalis*, the Fall Mackerel, *Scomber grex*, the Tunny, *Thynnus vulgaris*, the Swordfish, *Xiphias gladius*, the Bluefish, *Temnodon saltator*, &c., inhabitants of the ocean.

The family GOBIDÆ is probably represented in the waters off our costs by the genus Zoarces, which contains the Thick lipped Eelpout, *Zoarces anguillaris*, and by the genus Anarrhicas, to which belongs the Sea Wolf, *Anarrhicas lupus*.

So also the family LOPHIDÆ, to which belongs the American Angler, *Lophius Americanus*, and the Toadfishes, BATRACHII, and likewise the family LABRIDÆ, in which is the Cunner, *Ctenolabrus cereuleus*, are no doubt met with on our shores.

In the abdominal division of the Malacopterygii are six families, which are widely diffused through the lakes and streams of Canada, namely, SILURIDÆ, CYPRINDÆ, ESOCIDÆ, SALMONIDÆ, CLUPIDÆ, and SAURIDÆ.

The only representative of SILURIDÆ that we have is the genus Pimelodus, of which there are several species. The most widely known is the common Catfish *Pimelodus catus*, which frequents nearly every muddy bottom to be found in our ponds, lakes and streams. This fish has the first ray of the dorsal and pectoral fins spinous, thus forming an exception to the rule in soft-rayed fishes, as every angler well knows who has had occasion to take them from his hook, and in unsuspecting haste rushed upon the sharp points and yet sharper seratures of these formidable spines. There is also the Channel Catfish, *Pimelodus nigricans*, at once distinguished from the former by his forked tail and the irregular round black spots on the body. Agassiz describes a species found in Lake Superior, to which he has given the name *Pimelodus felis*. This genus will reward the student's careful examination of every individual that falls under his notice, for the scientific world is yet in doubt as to the number of species that should compose Pimelodus proper.

In CYPRINIDÆ, the Carp family, we have several species of the genus Catastomus and of the genus Leuciscus. The common Sucker, *Catastomus communis*, and the Mullet Sucker, *Catastomus aureolus*, are perhaps the most common species of this genus.

Here also there is opportunity for careful examination by the Canadian student, as accurate descriptions of the different species are very much needed. Agassiz has recently given a description of two species from Lake Superior, with which comparison may be instituted in the study of specimens, and order be brought out of the present confusion. There is a great multiplicity of species of the genus Leuciscus ; how many of them will be found in our waters I am not prepared to say: doubtless there is the Black-nosed Dace, *Leuciscus atronasus*, in many places called the Brook Minnow, the Redfin or Rough-head, *Leuciscus cornutus*, and the Shining Dace, *Leuciscus nitidus*. Indeed I am quite sure I have seen the two latter in the streams in the neighborhood of Lake Memphremagog. Agassiz describes two new species from Lake Superior, closely resembling *Leuciscus cornutus*, which he calls *Leuciscus frontalis* and *Leuciscus gracilis*, and probably other species will be found in our streams and lakes by the careful Naturalist.

The Pickerel family, *Esocidæ*, seems to be at home in Canadian waters, and the careful student will be very likely to meet with new and undescribed species of the genus Esox, to which belongs the great Mascalonge, *Esox estor*, the common Pickerel, *Esox reticulatus*, the Northern Pickerel, *Esox Boreus*. I have been informed by an enthusiastic student of nature, who has the means of knowing, that the Ojibway Indians call our *Esox estor* the Maskinongé, whence it has been corrupted into Mascalonge.

The Salmon family, SALMONIDÆ, are peculiar to the northern temperate regions; and between the great lakes and Arctic seas will be found several genera, each of which includes a number of species. The noble Salmon is the type of this family, to which an article has been devoted in a previous number, and to the same genus belong that speckled beauty, the Brook Trout, *Salmo fontinalis*, and the great Lake Trout, *Salmo namaycush*, the Siskawitz, *Salmo siskawitz*, recently discovered by Agassiz in Lake Superior, the Salmon Trout, *Salmo trutta*, which is found only in the Gulf of St. Lawrence and in the estuaries of New Brunswick and Nova Scotia, and the Masamacush, *Salmo Hoodii*. To this family belongs the genus Coregonus, the species of which fall so naturally into two groups that Agassiz proposes to divide them into two genera, calling the group which have the lower jaw longer than the upper ARGYROSOMUS, and for that which has the upper jaw longer than the lower retain the name of Coregonus. This genus may be studied in the *Attihawmeg* or Whitefish, and what in the neighborhood of the Lakes are called Herring, though they are not herring at all, but a species of *Coregonus*.

The Herring family, Clupidæ, may be studied on the coast in the American Herring, *Clupea elongata*, and in the American Alewive, *Alosa tyrannus;* in our inland waters it is represented by the genera Hyodon and Amia, of which will be found the Lake Mooneye, *Hyodon clodalis*, and the Dog-fish, *Amia ocellicauda*.

The family Sauridæ is peculiarly interesting, from the close resemblance to the Saurian fishes of past geological ages. It may be studied in the genus Lepidosteus, the Garfishes, which are found in the great chain of lakes from Lake St. Clair to the Gulf of the St. Lawrence. A careful study of its embryology, in the opinion of Agassiz, would throw great light upon the history of the succession of fishes of all geological periods, and indicate the manner in which the separation of true icthyological characters from reptilian was introduced. I know not whether we have more than one species in Canada, the *Lepidosteus Huronensis*.

In the subbrachial division of the soft-rayed fishes are two families largely represented on our coast, the Gadidæ and Planidæ. The former can be studied in the American Codfish, *Morrhua Americana*, the Haddock, *Morrhua æglefinis*, the American Hake, *Merlucius albidus*, &c.; the latter in the Halibut, *Hyppoglossus vulgaris*, the Flatfishes, *Platessa plana*, &c.

The fishes of Canada present to the student of nature a large field of observation as yet but partially traversed, and one which will well repay minute investigation, one where he may hope to find species hitherto unobserved and undescribed, and where, by a more careful description and comparison of those already noted, he may contribute much to the progress of science. Let him not think minute examination unnecessary, for it is from the most minute examination of individuals that we derive our grandest generalizations; it is by making sure each step in our progress that we gain those heights which enable us to take in at one view the grand scheme of creation, and trace its beautiful unity from the days when fishes were the sole representatives of the vertebrates down to the last act of creative power, man.

ARTICLE XLIV.—*On some of the Game Birds of Canada.*

The Partridge or Quail, (*Ortyx Virginiana.*)

This bird, so well known in Western Canada, does not, so far as we have been able to learn, occur in any part of the Province east of Kingston, at the lower end of Lake Ontario. Even there, we are informed, it is but rarely seen. It is probable that the pine clad forests of the Laurentian series of rocks have been an effectual bar against its progress in that direction. The bird is a denizen of the treeless plains, or open forests; and as these seldom occur on the rugged ridges of hills, which characterize the formations we have mentioned, the Partridge cannot there support existence. So true it is that the Geology of a country exerts an influence over its Zoology. No doubt that if the plains of the west extended further to the east the Partridge would also be found ranging into Lower Canada. It is a species, however, of the warmer and more temperate regions, and it could not therefore proceed much further north of its present dominion. The following accounts of the natural history of this bird, we have gleaned from several authors:

"In their natural, undisturbed state, Partridges delight in the open country, frequenting without fear the stubble fields appertaining to the well-cultivated farms of our agriculturists, where they can obtain a plentiful supply of loose grain. The morning and evening is the time when Partridges feed. When the weather is favorable, they leave their roost at an early hour of the day, and, being very industrious feeders, they are soon able to retire from the open fields to some favorite and secluded spot, to bask themselves in the mid-day sun, or roll themselves in the dust to rid their plumage of the vermin with which all birds more or less are infested.

"Partridges are not strictly migratory birds, as the greater portion of them remain distributed throughout the northern portions of our country during the whole winter, and not unfrequently suffer immensely from the intense cold and deep snows; still, at that period of the autumn known as the "running season," large numbers abandon their former haunts, and, continuing along the borders of our rivers, take up their abode for a time in the lowlands, hundreds of miles, perhaps, from their breeding-places. In the northern sections of our country, the ground is frequently covered for weeks with snow; and, all access to food being thus cut off, these poor birds, driven by stern necessity, often become quite tame, visiting the barnyards, and even mixing with the poultry, to gain a scanty subsistence, which not unfrequently preserves them from actual starvation.

"Partridges commence pairing in the month of March, early or late, according to the state of the weather and, even after separating for the purposes of procreation, it is not unusual for them to reassemble in coveys as before, provided the weather should again become stormy and cold, as is often the case in our changeable climate.

"They generally complete their nests in five or six weeks after pairing. A small tuft of grass, sheltered by a bush or a tree, the corner of a worn fence, or the foot of an old stump, are the spots usually selected for the building of their nests, which are composed of leaves, dry grass, and a few feathers plucked from her own person. The little habitation is rudely but often ingeniously constructed; and, being so well concealed from observation, it not unfrequently bids defiance to the searching glances of the most inquisitive eye, as well as affording ample protection on every side from the inclemency of the weather. The eggs are white, and average from fifteen to twenty in number, and, in some rare instances, greatly exceed that quantity. If the birds be in their prime, and the season very favorable, it is not improbable that the female may deposit twenty-five or even thirty eggs, but such cases are anomalies; and we should be more disposed to attribute the unusual increase of eggs to an occasional propensity that some birds have of laying in each other's nests. Mr. Daniel, speaking of the amazing fecundity of the English Partridge, which is closely allied to our species, states that a nest was discovered with thirty-three eggs in it, another with twenty-eight, and another with thirty-three. The greatest number we have ever seen in the nest of the American bird is twenty-four; but we have often been told by farm hands that twenty-five is no unusual number. For the truth of these vague assertions we cannot, however, vouch. The period of incubation is about twenty-one days; some contend for a longer period, but we believe the former statement the more correct, although, in proof of the latter assertion, it has been argued that it requires four weeks to hatch the eggs when placed under a common hen. This, however, proves nothing, as the disparity in the time may be accounted for by the circumstance of the Partridge sitting much closer than the domestic fowl, and, consequently, generating a larger amount, if not a higher degree, of animal heat.

"The female bird during the period of incubation becomes quite poor, and undergoes the process of a partial moult, which provides a few downy feathers to assist in keeping the eggs warm during her absence from the nest in quest of food. The young birds are quite strong when they first burst from their narrow confines; and it is no very uncommon thing for them to be seen running about with a portion of the shell adhering to their backs. While the hen is sitting, and even after the birds are hatched, her mate may often be seen early in the mornings, or late in the afternoons, perched on a fence rail or low limb of a tree, whistling with all diligence for a half hour at a time, as if to cheer the female in her arduous and solitary duties. Partridges are strictly monogamous; and it is supposed by some that the cock assists the hen in covering the nest; and we incline to the opinion that these birds, in common with many others, do share the cares of hatching the little brood.

"If the weather remains dry and mild after hatching, the young birds will be able to fly in the course of three or four weeks; if, on the other hand, the season should be backward and inclement, the tender little brood gains strength but slowly, and great numbers consequently will fall victims to the damp and cold, while being led about in search of food.

"As soon as the anxious mother abandons her nest, attended by her nimble little progeny, she is joined by the cock Partridge, who gives all his attention to the searching for food and protecting the active little brood from any danger that may beset them. At the first alarm, the young birds instinctively skulk in the deep grass and remain perfectly motionless, while the old ones resort to every artifice within their power to ward off the impending danger. It is interesting to observe the earnest solicitude with which both the parents watch over their young, and the wonderful instinct they exhibit in guarding them when surprised by the huntsman, before they are sufficiently fledged to fly off. The old birds take to the wing, and the young ones run with all speed into the nearest thicket, or conceal themselves in the brushwood, or long grass that abounds at this season on their feeding-grounds. The hen, after flying a few hundred yards, alights, and returns by a circuitous route to the place she just abandoned; and, calling in subdued tones, she soon collects around her the scattered progeny, and quickly leads them off from the scene of danger. The cock Partridge at the same time is using every effort to distract the attention of the intruder by flying or rather tumbling confusedly before him, running along the ground, hanging his wings, fluttering as if badly wounded and unable to escape his every grasp. By such like artifices, the male bird strives to delude the eager observer, and deceive, perchance, his no less anxious dog; for, leading them both away, step by step, from the young covey, sufficient time is gained for the female to perform her important task. When the danger is passed, the hen bird, by her joyful call, directs the mate to her retreat.

"It is not only in devices of this kind that Partridges display a strong and lively affection for their young, but where there appears a probability of success, they will not hesitate to attack any enemy that assails them; and it is no uncommon thing for the old ones to be seen flying up at hawks, or other birds of prey, screaming and fighting with all vigor to defend their helpless offspring. Several years ago we witnessed a desperate battle between a cock Partridge and a black snake, which rather singular combat would, however, have soon proved fatal to the former, if we had not so opportunely come to his rescue, as the serpent had already caught the exhausted bird by the wing, and so deadly was the grasp that he even held on to his affrighted, but nevertheless courageous victim, after we had broken his back with a blow from a large stick. On searching around in the grass, we discovered two very young Partridges, somewhat mutilated, and nearly dead, both of which no doubt had been seized by his snakeship as a dainty meal, which he was not, however, permitted to enjoy, owing to the bold attack of the parent bird.

"The wild nature of the Partridge renders its domestication almost impossible, though in some instances, where the eggs have been placed under the common hen, they have been hatched and reared with as much success as if the progeny were of her own species. The young brood, however, though perfectly familiar with all the other occupants of the farm-yard, and apparently reconciled to their unnatural mode of life, still exhibited the wandering and restless disposition of their race, and in most instances have flown away to their native haunts at the pairing season of the following year. The American Partridge, in common with those of other countries, cannot bear close confinement; they may appear for a time to thrive, still, if too much restricted in their movements, invariably die. We unfortunately, during the last winter, lost several fine birds that were presented to us by our friend G. D. Wetherill, Esq., owing, we suppose, to the smallness of the cage in which we had temporarily placed them."—*From Lewis' American Sportsman.*

This bird feeds upon seeds, berries and various grains, in the open fields, and is particularly fond of Indian corn. Its note is a clear loud whistle, composed of three notes, the first and last nearly equal in length, and louder than the intermediate one. In the breeding season the call of the male consists of three notes, having a fancied simularity to the words *Ah Bob White*, which he repeats from a fence, stake, or low branch of a tree for hours together. At night they rest upon the ground, either in the grass or under a log or other cover. When there is a flock of them, they dispose of themselves in their resting place in a circle, their bodies touching each other, and their heads outward. This arrangement enables them when alarmed to fly away in different directions at once. They are easily caught in snares, and when kept in cages on coops, soon become very fat, but all attemps to domesticate them have been unsuccessful. In the autumn they perform occasional migrations in the manner of the wild turkey, their flight is rapid, and performed at a short distance from the ground. They are said to live from seven to ten years.

In Eastern Canada the Grouse is commonly called a Partridge. The true American Partridge, the subject of this notice is, however, a very different bird. The following is a discription of this species, taken from Wilson's Ornithology. We shall give a synopsis of the genera of the family to which it belongs in another place:

"The Partridge is nine inches long, and fourteen inches in extent; the bill is black; line over the eye, down the neck, and whole chin, pure white, bounded by a band of black, which descends and spreads broadly over the throat; the eye is dark hazel; down neck and upper part of the breast, red brown; sides of the neck spotted with white and black, on a reddish brown ground; back scapulars and lesser coverts, red brown intermixed with ash, and sprinkled with black; tertials edged with yellowish-white, beautifully marked with numerous curving spots or arrowheads of black; tail, ash, sprinkled with reddish brown; legs, very pale ash."

This bird breeds all over the United States, from Massachusetts to Texas, and thence northerly to the upper tributaries of the Missouri River. The generic name is Greek, *ortyx* a quail.

THE RUFFED GROUSE.—(*Tetrao Umbellus.*)

This bird is commonly called "the Partridge" in Canada and the Eastern United States, while in the West it is called the *Pheasant.* Next to the wild turkey it is considered to surpass as an article of food all other land birds of America, while to the sportsman and the student of nature its habits are full of interest. It is found in all the United States as far south as Maryland, and in all the British Provinces as far north as the Soscatchawan River. Its geographical distribution is therefore much more extensive than that of the American Partridge, (*Ortyx Virginiana.*)

These birds love to frequent the craggy sides of hills, and mountains, and also during the breeding and summer season prefer the borders of open spaces, such as beaver meadows or tracts where the trees have been destroyed by fire. Its food consists of seeds and berries of all kinds; and in the winter when the ground is deeply covered with snow in all the northern portion of their territory, the Grouse feed principally upon the buds of trees such as those of the birch and soft maple. They spend the greater portion of their time upon the ground in search of food. "The female makes her nest in May, beside a prostrate tree, or at the foot of a low bush, on the ground, in a spot where a heap of dried leaves has been formed by the wind. The nest is composed of leaves or dried twigs. The female lays from five to twelve eggs which are of a uniform dull yellowish colour, and are proportionate in size to the bird. She never covers them on leaving the nest, and in consequence, the raven and the crow, always on the look out for such dainties, frequently discover and eat them. When the female is present, however, she generally defends them with great obstinacy, striking the intruder with her wings and feet, in the manner of the common hen.

"The young run about and follow the mother the moment after they leave the egg. They are able to fly for a few yards at a time, when only six or seven days old, and still very small. The mother leads them in search of food, covers them at night with her wings, and evinces the greatest care and affection towards them on the least appearance of danger, trying by every art in her power to draw the attention of her enemies to herself, feigning lameness, tumbling and rolling about as if severely wounded, and by this means generally succeeding in saving them. The little ones squat at the least chuck of alarm from the mother, and lie so close as to suffer one to catch them in the hand, should he chance to discover them, which, however, it is very difficult to do. The males are then beginning to form small parties, and continue separated from the females until the approach of winter, when males, females and young mingle together. During summer these birds are fond of dusting themselves, and resort to the roads for that purpose, as well as to pick up gravel." (Audubon, vol. 5, p. 79.)

In the spring the woods where these birds are common resound with the drumming of the male, which is thus performed: the male bird, standing erect on a prostrate decayed tree, raises the feathers of its body in the manner of a turkey-cock, draws its head towards its tail, erecting the feathers of the latter at the same time, and raising its ruff around the neck, suffers its wings to droop, and struts about on the log. A few moments elapse, when the bird draws the whole of its feathers close to its body, and stretching itself out, beats its sides with its wings in the manner of the domestic cock, but more loudly, and with such rapidity of motion, after a few of the first strokes, as to cause a tremor in the air not unlike the rumbling of distant thunder; in perfectly calm weather this sound may be heard two hundred yards. The female never drums. The male occupies the same tree for drumming during the season, and it may be easily recognized by the quantity of excrements and feathers.

The bird when started by a man or dog rises suddenly from the ground with a loud whirring noise which, according to Audubon, is only made when the bird is alarmed. He says that he has often seen the Grouse rise from the ground of its own accord as gently and softly as any other bird, and without producing any whirring sound whatever. Its flight is straight forward and is seldom protracted beyond a few hundred yards at a time. Sometimes when started on the sides of a steep hill the Grouse will dive towards the foot of the declivity, and take a sudden turn to the right or left in a direction so unexpected that unless the sportsman is aware of the trick he may not put up the bird again that day.

Audubon says that the prevailing notion which exists in almost every district where these birds are numerous, that on firing at the lowest bird perched on a tree, the next above will not fly, and that by continuing to shoot at the lowest in succession, the whole may be killed, is contradicted by his experience; for on every attempt which he has made to shoot several in this manner on the same tree, his efforts have proved unsuccessful, unless during a fall of snow when he has killed three and sometimes four. The same cause produces the same effect on different birds. It may happen, he says, that in districts covered with deep snow for several weeks, during severe winters, these birds, becoming emaciated and weak, may stand a repetition of shots from a person determined to shoot Grouse even when they are good for nothing, but not when they are in good order. When this bird alights on a tree after being raised, it stands perfectly still in an erect attitude, and may then be closely approached. When the ground is covered with snow sufficiently soft to allow this bird to conceal itself under it, it drives headlong into it, with such force as to form a hole several yards in length, re-appears at that distance, and continues to elude the sportsman by flight. They are sometimes caught while beneath the snow.

The Ruffed Grouse is eighteen inches long, and twenty-three in extent; bill a horn color; eye reddish hazel, immediately above which is a small spot of bare skin of a scarlet color; crested head, and neck variegated with black, red, brown, white and pale brown: sides of the neck furnished with a tuft of large black feathers, twenty-nine or thirty in number, which it occasionally raises; body above of a bright rust color, marked with oval spots of yellowish-white, spotted with olive; the tail is rounded, extends five inches beyond the tips of the wings, is of a reddish-brown, barred and minutely mottled with black, and terminated by a broad band of the latter color between two narrow bands of bluish white, of which one is terminal; a yellowish white band from the upper mandible to the eye, beyond which it is prolonged; throat and lower part of the neck, light brownish yellow; lower ruff feathers of the same color, barred with reddish brown, the upper black, with blue reflections; a tuft of light chesnut feathers under the wings; the rest of the under parts yellowish white, with broad transverse spots of brownish red; the abdomen yellowish red, and the under tail coverts mottled with brown.

The plumage of the female is less developed and of inferior beauty. The feathers of the head and ruff are less elongated, the latter of a duller black. The tints of the plumage generally are lighter than the male.

The generic name *tetrao* is Latin, probably derived from the Greek *tetrax*, a *moor fowl.* The specific name is from the Latin *umbella*, which may be translated a " ruff."

THE SPRUCE PARTRIDGE OR CANADA GROUSE, (*Tetrao Canadensis.*)

The Canada Grouse, or Spruce Partridge as it is commonly called, is not so abundant in the settled portions of Canada as the species just described in the more retired recesses of the forest; it is, however, often met with, and it appears at no great distance from the large towns. G. W. Allan, Esq., of Toronto, says he has had specimens brought " which were said to have been procured not many miles distant" from that city.

Audubon thus describes the habits of this beautiful bird:

The Spruce Partridge or Canada Grouse breeds in the States of Maine and Massachusetts about the middle of May, nearly a month earlier than at Labrador. The males pay their addresses to the females by strutting before them on the ground or moss, in the manner of the turkey cock, frequently rising several yards in the air in a spiral manner, when they beat their wings violently against their body, thereby producing a drumming noise, clearer than that of the Ruffed Grouse, and which can be heard at a considerable distance. The female places her nest beneath the low horizontal branches of fir trees, taking care to conceal it well. It consists of a bed of twigs, dry leaves and mosses, on which she deposits from eight to fourteen eggs, of a deep fawn colour, irregularly splashed with different tints of brown. They raise only one brood in the season, and the young follow the mother as soon as hatched. The males leave the females whenever incubation has commenced, and do not join them again until late in autumn; indeed, they remove to different woods, where they are more shy and wary than during the love season or in winter.

This species walks much in the manner of our Partridge. I never saw one jerk its tail as the Ruffed Grouse does, nor do they burrow in the snow like that bird, but usually resort to trees to save themselves from their pursuers. They seldom move from thence at the barking of a dog, and when roused fly only to a short distance, uttering a few *clucks*, which they repeat on alighting. In general, when a flock is discovered, each individual forming it may be easily caught, for so seldom do they see men in the secluded places which they inhabit, that they do not seem to be aware of the hostile propensities of the race.

Along the shores of the Bay of Fundy, the Spruce Partridge is much more abundant than the Ruffed Grouse, which indeed gradually becomes scarcer the farther north we proceed, and is unknown in Labrador, where it is replaced by the Willow Ptarmigan, and two other species. The females of the Canada Grouse differ materially in their colouring in different latitudes: in Maine, for instance, they are more richly coloured than in Labrador, where I observed that all the individuals procured by me were of a much greyer hue than those shot near Dennisville. The like difference is perhaps still more remarkable in the Ruffed Grouse, which are so very grey and uniformly coloured in the Northern and Eastern States, as to induce almost every person to consider them as of a species distinct from those found in Kentucky, or any of the southern mountainous districts of the Union. I have in my possession skins of both species procured a thousand miles apart, that present these remarkable differences in the general hue of their plumage.

All the species of this genus indicate the approach of rainy weather or as now storm, with far more precision than the best barometer; for on the afternoon previous to such weather, they all resort to their roosting places earlier by several hours than they do during a continuation of fine weather. I have seen groups of Grouse flying up to their roosts at mid-day, or as soon as the weather felt heavy, and have observed that it generally rained in the course of that afternoon. When, on the contrary, the same flock would remain busily engaged in search of food until sunset, I found the night and the following morning fresh and clear. Indeed, I believe that this kind of foresight exists in the whole tribe of gallinaceous birds.

One day, while on the coast of Labrador, I accidentally almost walked upon a female Canada Grouse surrounded by her young brood. It was on the 18th of July. The affrighted mother, on seeing us, ruffled up all her feathers like a common hen, and advanced close to us as if determined to defend her offspring. Her distressed condition claimed our forbearance, and we allowed her to remain in safety. The moment we retired, she smoothed down her plumage, and uttered a tender maternal chuck, when the little ones took to their wings, although they were, I can venture to assert, not more than *one week old*, with so much ease and delight, that I felt highly pleased at having allowed them to escape.

Two days afterwards, my youthful and industrious party returned to the Ripley with a pair of these Grouse in moult. This species undergoes that severe trial at a much earlier season than the Willow Ptarmigan. My son reported that some young ones which he saw with their mother were able to fly fully a hundred yards, and alighted on the low trees, among which he caught several of them, which, however, died before he reached the vessel.

This species is found not only in the State of Maine, but also in the mountainous districts of New Hampshire, and the northern parts of New York, as well as around our northern great lakes, and the head waters of the Missouri. It is abundant in the British Provinces of New Brunswick, Nova Scotia, Newfoundland and Labrador.

Among the great number, procured at all seasons of the year, which I have examined, I never found one without the rufous band at the extremity of the tail, represented in the plate; nor did I see any having the terminal white spot on the upper tail-coverts exhibited in figures of this species.

Their food consists of berries of different sorts, and the young twigs and blossoms of several species of plants. In the summer and autumn I have found them gorged with the berries of the plant represented in the plate, and which is commonly called "Solomon's Seal." In the winter I have seen the crop filled with the short leaves of the larch or hackmetack.

I have frequently heard it said that these birds could be knocked down with sticks, or that a whole covey could be shot while perched on trees, by beginning at the lowest one; but I have never witnessed any thing of the kind, and therefore cannot vouch for the truth of the assertion. During the autumn of 1833, these birds were uncommonly abundant in the State of Maine. My friend Edward Harris, of New York, Thomas Lincoln, and others, killed a great number; and the last mentioned gentleman procured a pair alive, which were fed on oats and did well.

The flesh of this Grouse is dark, and fit for being eaten only when it has fed on berries. In winter, when it feeds on the leaves of trees and other plants, the flesh is quite bitter and disagreeable.

According to Dr. Richardson, all the thick and swampy black-spruce forests between Canada and the Arctic Sea abound with this bird, and considerable numbers exist in the severest seasons as high as the 67th parallel. I am informed by Mr. Townsend that it is also plentiful on the Rocky Mountains and the plains of the Columbia, from which parts I have obtained specimens differing in nothing from others procured in Maine and Labrador. I have also compared those in the Edinburgh Museum, which Mr. Douglass was pleased to name *Tetrao Franklinii*, with several of my own, and feel perfectly confident that they are all of one and the same species.

Description.—Tail of sixteen feathers, rounded; male with the upper parts transversely banded with brownish black and light gray; wings variegated with dusky and greyish yellow; quills brown the outer webs of the primaries mottled with yellowish; tail blackish brown, tipped with reddish yellow; lower parts black; the feathers near the throat with a white spot near the end; a band of white spots behind the eye; on the breast the feathers with a broad subterminal spot, and the lower tail coverts largely tipped with white; female with the upper parts as in the male, but more broadly barred; head; sides of neck, fore-neck and anterior part of breast, yellowish red, barred with brownish black; lower parts greyish black, barred with reddish white; tail minutely mottled, and tipped with reddish brown.

Male 15¾—*Female* 15½ = 21.

Breeds from the northern part of New York to Labrador as well as from Canada to the Arctic Sea, Columbia River; partially migratory in winter. (Audubon's Synopsis, page 203.)

The Snipe, (*Scolopax Wilsonii.*)

The Snipe, so highly prized by sportsmen, is common throughout the United States and the British Provinces, its breeding grounds, however, being in the northern portions of these extensive regions. In the Southern States it is not seen in summer, but in winter is exceedingly abundant; we are informed that occasionally a stray Snipe is to be met with in Canada, so late in the season as the beginning of January, but such must be regarded as stragglers who have loitered behind long after the great body of the species has returned to the southern climes.

Audubon says that in the northern districts, meaning Maine, Nova Scotia, the Northern States, and Canada, "the Snipe begins to lay its eggs in the early part of June. The swampy parts of the extensive moss-covered marshes in elevated situations afford it places of security and comfort, in which it is not likely to be disturbed by man, and finds immediately around it an abundance of food. The nest itself is a mere hollow in the moss, scantily inlaid with a few grasses. The eggs are four, placed with the small ends together, and measure one inch and five-eighths by one and one-eighth, being pyriform, with the tip somewhat inflated. The ground colour is a yellowish, olive, pretty thickly spotted, and blotched with light and dark umbers, the markings increasing in size as they approach the large end, where they form a circle. The young, like those of the woodcock, leave the nest as soon as they are hatched, and so resemble those of the common Snipe of Europe, *Scolopax gallinago*, that the same description answers for both, they being covered with down of different tints of brown and greyish yellow. The bill, at this age, is short, very soft and easily bent by the least pressure, nor does it acquire its full growth before winter; and its length differs in different apparently full grown individuals, by half an inch or even three-fourths. They seem to feed at first upon minute insects collected on the surface of the mires, or amid the grass and moss, but as they grow older and the bill becomes firmer and larger, they probe the ground like their parents, and soon become expert in this operation, introducing the bill at every half inch or so of the oozy mire, from which they principally obtain their food. In the middle States this Snipe, however, has been found breeding in meadows, as well as in the State of Maine; and it also nestles in the mountainous districts of these parts of the Union."

After spending the summer in the north these birds remove southward in October, and then become so numerous in some of the states that hundreds may be shot in the same field. When started they there rise in the air in flocks, each one emitting its cry, *wau-aik*, after which they fly around a few times and then suddenly alight not many yards from the spot where they were. They occasionally are attached so much to one spot that they will repeatedly return no matter how often they may be shot at, until the greater part of the flock is killed. Audubon says "they are abundant in the wet savannahs in the Floridas, from which they retire a few weeks earlier than from Louisiana and the Carolinas, where some remain until the beginning of April. During the whole of the winter months, these birds are observed to ramble from one place to another, and a field which yesterday contained a good number, has only a few to day, and to-morrow may be quite deserted; but before the end of the week there you will find them again, as abundant as at first. They rarely visit salt waters, and never resort to the interior of the woods."

The food of the Snipe consists principally of ground worms, insects, and the juicy slender roots of different vegetables; all of which tend to give its flesh that richness of flavour and juicy tenderness for which it is so deservedly renowned, it being equal to that of the Woodcock. Many epicures eat up the Snipe and Woodcock with all their viscera, worms and insects to boot, the intestines in fact, being considered the most savory part. On opening some newely killed Snipes, I have more than once found fine large and well fed ground worms, and at times a leech, which I must acknowledge I never conceived suitable articles of food for man, and for this reason I have always taken good care to have both Snipes and Woodcock well cleaned, as all game ought to be.

The following is from Lewis' American Sportsman :

There are several game varieties of Snipe known in the Old World, and all equally sought after by sportsmen ; there are also many species in our own country, but only one that attracts much attention from our shooters. In Russia, there is a large Snipe that occasionally wanders as far as England, and is known there, we believe, as the Horseman's Snipe, from its superior size and fine appearance. This bird affords much sport to the Russian Noblesse, as well as a savory dish for their tables. The Double, or Solitary Snipe, Scolopax Major, although quite rare in England, is very common in Sweden; it is nearly twice as large as the common Snipe, and offers attractive amusement to the inhabitants of that country, who pursue field sports with as great zest as the sportsmen of our own country. The Scolopax Gallinago, or English Snipe of America, is closely allied to the common snipe of the Old World—it resembles it in plumage, size, and habits ; a little difference, perhaps, may be conceded to the latter variety in point of weight. The observant Wilson, in his usual style of close investigation, discovered a very marked distinction between the English and American bird, and in consideration of this discovery, Temminck and other European Naturalists have very justly dedicated the American Snipe to this distinguished Ornithologist, by bestowing upon it the title of Scolopax Wilsonii, or Wilson's Snipe, a compliment not less deserved than generously awarded. Wilson states that the American Snipe has the same soaring, irregular flight in the air during gloomy weather, as the Snipe of Europe; the same bleating note and occasional rapid descent; springs from the marshes with the like feeble "squeak," and in every respects resembles the common Snipe of Britain, except in being about one inch less, and in having sixteen feathers in the tail instead of fourteen. Audubon, however, informs us that the notes of the two varieties are quite dissimilar, in fact, as different from each other as those of the American Crow and the Carrion Crow of Europe, and expresses some surprise that Wilson should not have mentioned this difference.

Frank Forrester, on the other hand, observes that the cry of the two varieties is *perfectly identical*, and in this statement, he further remarks that he is corroborated by the judgment of several English sportsmen with whom he has frequently shot.

This Snipe is known in Britain as the Common Snipe, Snipe, or Heather-bleater, and with us is called English Snipe or Wilson's Snipe. In Louisiana, the Creoles term it *cache-cache*, the derivation of which, we imagine, arose from the well-known retired or lurking habits of the bird.

"The Snipe is eleven inches long, seventeen inches in extent; the bill over two inches and a-half long, fluted lengthwise; brown color; black towards the tip, crown black, divided by an irregular line of pale brown; another broader hue of the same tint passes over each eye; from the bill to the eye there is a narrow dusky line; neck and upper part of the breast pale brown, variegated with touches of white and dusky; chin pale; back and scapulars deep velvety black, the latter elegantly marbled with waving lines of ferruginous, and broadly edged, exteriorly, with white; wings plain dusky; all the feathers, as well as those of the coverts, tipped with white; shoulder of the wing deep dusky brown, exterior quill edged with white; tail coverts long, reaching within three-quarters of an inch of the tip, and of a pale rust-color, spotted with black; tail rounded, deep black, ending in a bar of bright ferruginous, crossed with a narrow waving line of black, and tipped with whitish; belly pure white; sides barred with dusky; legs and feet a very pale, ashy green; sometimes the whole thighs and sides of the vent are barred with dusky and white. The female differs in being more obscure in her colors; the white on the back being less pure, and the black not so deep."

In the spring season, the Snipe performs some very singular manœuvres, not very unlike those that are noticed in the Woodcock, during the period of incubation. If the sportsman should, at early dawn, or even at mid-day, visit the low meadows frequented by those birds, he will probably see one or both of a pair mounting high in the air in a spiral manner, beating their wings or sailing around in rapid circles, until they have gained a hundred yards or more in height; then clasping each other, they whirl around flapping their wings with great velocity, and then dropping in mid-air, give utterance at the same time to a low twittering, or rather rolling sound, supposed to be produced by the action of the wings upon the air in their rapid descent. We have seen them perform this manœuvre more than once, but at no other period of the year than the spring.

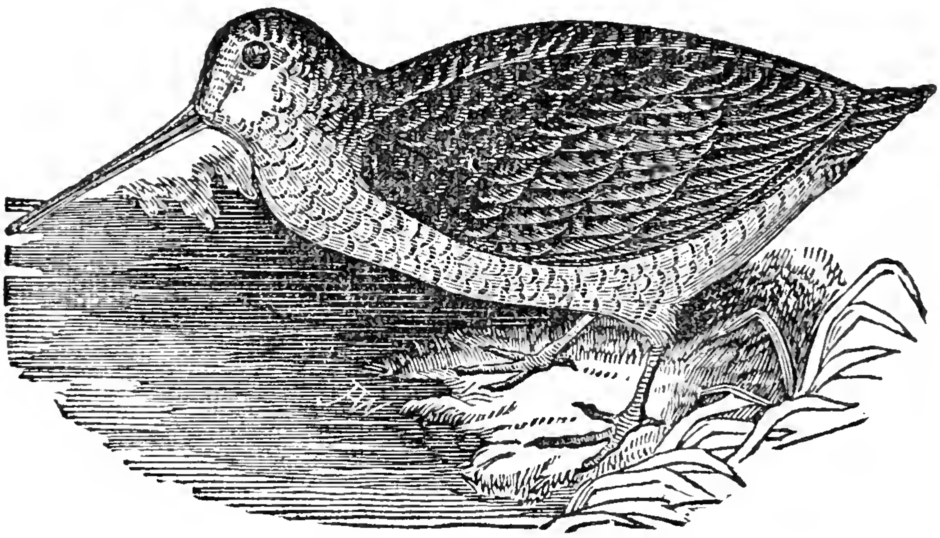
The flight of the Snipe, together with its shyness during its sojourn at the north, and the disagreeable nature of the ground that it alone frequents, renders it the most difficult as well as fatiguing and vexatious of birds to hunt. When sprung, they take wing very suddenly, and fly off in rapid zigzag lines for a few paces, in such a confused, irregular, and tortuous course that it is almost impossible even for a snap shot, during this time, to cover the bird for an instant while performing these elliptical gyrations.

Snipe-shooting, not only in England, but also in our own country, may very justly be pronounced the "Crux Jaculatorum" of sportsmen, as there is no game that requires more skill and judgment in shooting, or demands a greater share of labor and perseverance to follow. A sporting writer—no great admirer of this sport, however, we imagine—remarks that "Snipe-shooting is a sport the best calculated (Grousing excepted) to try the keenness of the sportsman, to ascertain his bottom, and if he can stand labor, water, mire, swamps, and bogs. He should he possessed of a strong constitution, not liable to catch cold, and have all the fortitude, as well as exertion, of a water spaniel; he should be habitually inured to wet, dirt, and difficulties, and not be deterred by cold or severe weather."

This statement, although a little overdrawn, is not far wide of the real truth, as every Snipe-shooter knows full well; and when entering on the sport, each one should be willing to repeat within himself *audax omnia perpeti.* Notwithstanding the numerous ills attendant on this sport, it has many ardent admirers, who, in spite of wind and weather, cold and rain, mud and mire, are, at each succeeding spring and autumn, found ready at their posts, all eagerness to commence the fray ; and, at the close of every season each one has a long list of adventures to relate, not perhaps—

> " Of moving accidents by flood and field,
> Of hair-breadth' scapes i' the imminent deadly breach ;"

but of many mishaps and hardships encountered during the campaign on the filthy marshes, the most of which, though grievous at the time, in reality added zest to the sport, and will ever remain imbedded on the memory of the true sportsman as playful souvenirs by which to recall the scenes of much past enjoyment.



THE WOODCOCK.

Microptera Americana, (Audubon.)
Scolopax Minor, (Wilson.)

The Woodcock arrives in Canada in the latter part of March, and immediately commences to make preparations for breeding. It is a bird so nocturnal in its habits that it may be quite abundant in a neighbourhood and still its presence not be suspected, unless by the sportsman who knows all the lurking places of the game in his vicinity. During the greater portion of the day they remain concealed in secluded thickets or marshes, and only come out to feed in the wide open places during the night, at sunset, or early dawn. They breed in the spring and summer in Canada and the Northern States, and spend the winter in the south. Wilson says "the Woodcock usually begins to lay in April. The nest is placed on the ground, in a retired part of the woods, frequently at the root of an old stump. It is formed of a few withered leaves and stalks of grass laid with very little art. The female lays four, sometimes five eggs, about an inch and a-half long, and an inch or rather more in diameter, tapering suddenly to the small end. These are of a dun clay color, thickly marked with spots of brown particularly at the great end, and interspersed with others of a very pale purple. The nest of the Woodcock has, in several instances that have come to my knowledge, been found with eggs in February; but its usual time of beginning to lay is early in April. In July, August, and September, they are considered in good order for shooting."

The Woodcock is properly a nocturnal bird, feeding chiefly at night, and seldom stirring about till after sunset. At such times, as well as in the early part of the morning, particularly in spring, he rises, by a kind of spiral course, to a considerable height in the air, uttering at times a sudden *quack*, till, having gained his utmost height, he hovers around in a wild, irregular manner, making a sort of murmuring sound; then descends with rapidity as he rose. When uttering his common note on the ground, he seems to do it with difficulty, throwing his head towards the earth, and frequently jetting up his tail. These notes and manœuvres are most usual in spring, and are the call of the male to his favorite female. Their food consists of various larvæ, and other aquatic worms, for which during the evening, they are almost continually turning over the leaves with their bill, or searching in the bogs. Their flesh is reckoned delicious, and prized highly. They remain with us till late in autumn, and, on the falling of the first snows, descend from the ranges of the Alleghany to the lower parts of the country in great numbers; soon after which, viz., in November, they move off to the south.

This bird, in its general figure and manners, greatly resembles the Woodcock of Europe, but is considerably less, and very differently marked below, being an entirely distinct species. A few traits will clearly point out their differences. The lower parts of the European Woodcock are thickly barred with dusky waved lines, on a yellowish white ground. The present species has those parts of a bright ferruginous. The male of the American species weighs from five to six ounces, the female eight; the European, twelve. The European Woodcock makes its first appearance in

Britain in October and November, that country being in fact only its winter quarters; for, early in March, they move off to the northern parts of the continent to breed. The American species, on the contrary, winters in countries south of the United States, arrives here early in March, extends its migrations as far, at least, as the River St. Lawrence, breeds in all the intermediate places, and retires again to the south on the approach of winter. The one migrates from the torrid to the temperate regions, the other, from the temperate to the Arctic. The two birds, therefore, notwithstanding their names are the same, differ not only in size and markings, but also in native climate. Hence the absurdity of those who would persuade us that the Woodcock of America crosses the Atlantic to Europe, and *vice versa*. These observations have been thought necessary, from the respectability of some of our own writers, who seem to have adopted this opinion.

How far to the north our Woodcock is found, I am unable to say. It is not mentioned as a bird of Hudson's Bay, and, being altogether unknown in the northern parts of Europe, it is very probable that its migrations do not extend to a very high latitude, for it may be laid down as a general rule that those birds which migrate to the Arctic regions, in either continent, are very often common to both. The head of the Woodcock is of singular conformation, large, somewhat triangular, and the eye fixed at a remarkable distance from the bill, and high in the head. This construction was necessary to give a greater range of vision, and to secure the eye from injury, while the owner is searching in the mire. The flight of the Woodcock is slow. When flushed at any time in the woods, he rises to the height of the bushes or underwood, and almost instantly drops behind them again at a short distance, generally running off for several yards as soon as he touches the ground. The notion that there are two species of Woodcock in this country probably originated from the great difference of size between the male and female, the latter being considerably the larger.

The male Woodcock is ten inches and a-half long, and sixteen inches in extent; bill, a brownish flesh color, black towards the tip, the upper mandible ending in a slight knob, that projects about one tenth of an inch beyond the lower, each grooved, and, in length, somewhat more than two inches and a-half; forehead, line over the eye, and whole lower parts, reddish tawny; sides of the neck, inclining to ash; between the eye and bill, a light streak of dark brown ; crown, from the forepart of the eye backwards, black, crossed by three narrow bands of brownish white ; cheeks, marked, with a bar of black, variegated with light brown ; edges of the back, and of the scapulars, pale bluish white ; back and scapulars, deep black, each feather tipped or marbled with light brown and bright ferruginous, with numerous fine zigzag lines of black crossing the lighter parts ; quills, plain dusky brown ; tail, black, each feather marked along the outer edge with small spots of pale brown and ending in narrow tips, of a pale drab color above, and silvery white below ; lining of the wing, bright rust ; legs and feet, a pale reddish flesh color ; eye, very full and black, seated high and very far back in the head ; weight, five ounces and a-half, sometimes six.

The female is twelve inches long, and eighteen in extent, weighs eight ounces, and differs also in having the bill very near three inches in length ; the black on the back is not quite so intense ; and the sides under the wings are slightly barred with dusky.

The young Woodcocks of a week or ten days old are covered with down of a brownish white color, and are marked from the bill along the crown to the hind head, with a broad stripe of deep brown ; another line of the same passes through the eyes to the hind head, curving under the eye ; from the back to the rudiments of the tail, runs another of the same tint, and also on the sides under the wings ; the throat and breast are considerably tinged with rufous ; and the quills at this age are just bursting from their light blue sheaths, and appear marbled, as in the old birds ; the legs and bill are of a pale purplish ash colour, the latter about an inch long. When taken, they utter a long, clear, but feeble *peep*, not louder than that of a mouse. They are far inferior to young Partridges in running and skulking ; and, should the female unfortunately be killed, may easily be taken on the spot."

Audubon says that when the Woodcocks are travelling from the south towards all parts of the United States, on their way to their breeding places, they migrate singly, and follow each other with such rapidity that they might be said to arrive in flocks, the one coming directly in the wake of the other. This is particularly observable by a person standing on the eastern banks of the Mississippi or the Ohio, in the evening at dusk, from the middle of March to that of April, when almost every instant there whizzes past him a Woodcock with a velocity equalling that of our swiftest birds. He states also that he has seen them in New Brunswick returning southward in equal numbers late in the evening, and in the same continuous manner within a few feet of the ground on the roads or through the woods. When the young birds are six weeks old, it requires nearly as much skill to shoot them as if they were much older.

The Woodcock is a particular favorite of the sportsman, and although the pursuit is laborious on account of the difficult nature of the ground in which the bird is found, yet no other shooting appears to be more fascinating. In Lewis' American Sportsman, from which work we have taken the figure of the bird, it is stated, with reference to finding Woodcocks, that "these birds, as before observed, delight in a wet loamy soil, and are seldom or never found in the upland districts, but most frequently locate themselves along the marshy willow and elder borders and extensive flats of our rivers. They also secrete themselves in the dense thickets of underbrush along the margins of smaller streams, or hide themselves in the rank grass and luxuriant fern of our wet meadow lands. In fact, wherever there is a good boring-ground, and a certain degree of seclusion, there will be found Woodcocks in the month of July, many or few, according to the nature of the ground and the favorable or unfavorable state of the breeding season.

When there has been a succession of dry weather, it is quite useless to examine light and open coverts, or sparse woods, in quest of Cocks, as at such times they will be found either on the open wet bottoms, if such spots can then be come across, or more likely in the deep, impermeable thickets and entangled brakes, where the ground seldom or never entirely loses its moisture. On the other hand, when the weather has been extremely wet for some days, Woodcocks will partake themselves to the hill-sides or elevated grounds, as they are not by any means partial to too much water, although a certain degree of moisture is absolutely necessary for their very existence. When the weather begins to get cool, they may also be found in the open woody glens or clearings, enjoying, as it were, the mild warmth of the autumn's sun, as the feeble rays from time to time pierce the sparse foliage of the overhanging trees, or actively engaged boring in the mossy banks of the warm rills, which so often spring up from such sheltered situations. In sections of the country where these birds resort, we can scarcely visit a spot of this kind early in October without finding a couple or so of Cocks, provided the ground is not too often overrun with shooters.

Still later in the season they may be met with in the more deep and sheltered wood swamps, where the insects, larvæ, and earth-worms, protected, in a measure, from the biting frosts of the more exposed situations, are enabled to remain near the surface during the severest weather; here it is that the sportsman will discover the perforations or borings of this lonely bird.

The warm and almost impenetrable cedar swamps are also favorite resorts for such Woodcocks as remain in the north during the cold weather, as the springs in such situations seldom freeze, and there is always to be found a scanty supply of suitable food even in the depth of winter. These birds, however, like the snipe, are very uncertain in their movements, being governed a good deal by the state of the weather, and other similar causes.

Woodcocks are very abundant in Jersey and Delaware, particularly after a dry spell of weather, as they congregate there from the interior of the country, and spread themselves over the wide extent of meadow lands and marshy cripples so congenial to their habits, and which are so general in the lower portions of these States. Cock-shooting in these districts is equally if not more laborious than Snipe-shooting, more particularly if pursued, as is, we may say, universally the custom, during the oppressively hot weather of July and August. In wandering over these extensive marshes, or, as they are vulgarly called, mashes, it is necessary for the sportsman to exercise considerable dexterity in stepping from tussock to tussock; otherwise he will often be doomed to a sudden plunge into the filthy oozes that surround him on every side. The excessive heat of the weather is anothor strong objection to the shooting of Woodcocks in the month of July, as the heat is often so oppressive that the birds will spoil in the course of a few hours after being shot, and, in some instances, even before leaving the field for the day. As for hoping to keep the birds over a day or two, to carry home, such a thing is quite impossible, and the sportsman, consequently, is forced to throw them away sometimes when only a day old, if he cannot procure ice to pack them in, which article, by the by, is not always to be had in the country.

The Woodcocks and Snipes are very closely related, and are classified under the genus *Scolopax* by some authors, while others think a separation necessary. The generic name is from the Greek "*micropteryx*," "that has small wings."

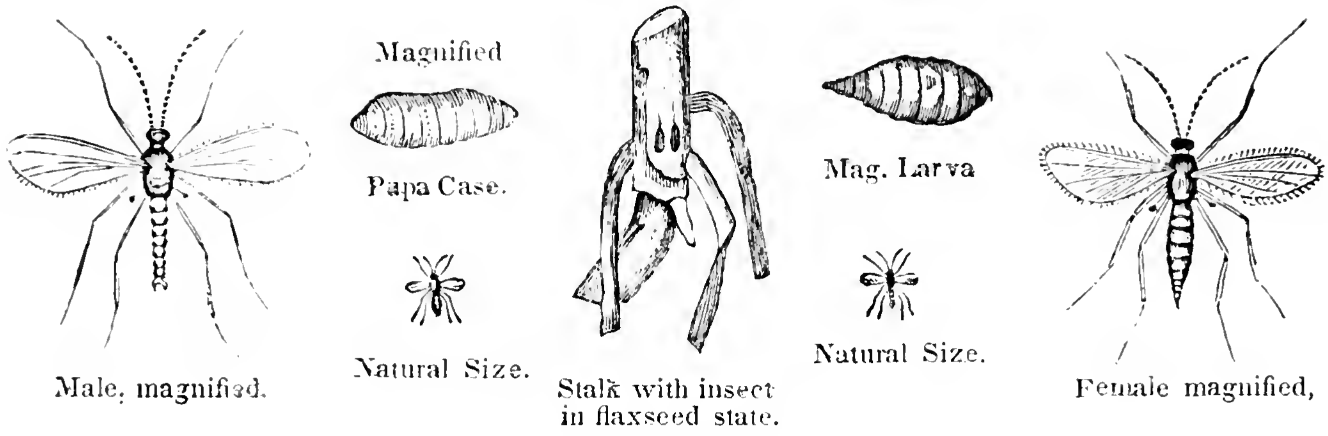
ARTICLE XLV.—*On the Insects injurious to the Wheat crop.*

The recent appearance of the Fly, in Upper Canada, having occasioned a good deal of anxiety, we have thought proper to publish the following article, in order to give as wide a circulation as possible to the Natural History of this destroyer of the staff of life. The Wheat Midge, *Cecidomya tritici*, appears to be the species which threatens our crops with the greatest amount of damage. Its history has been known to Naturalists during the last fifty years, but no effectual method has been discovered of guarding against its ravages. There is but one way of arriving at this much desired knowledge. It is by increasing the number of qualified observers throughout the country. Were any argument necessary to establish the expediency of introducing the study of Natural History into all the common schools throughout the civilized world, the best would be that a creature barely visible to the naked eye may, under circumstances favourable to its multiplication, scourge the nations with famine. We do not know how to protect ourselves, and we never shall know until we arrive at a more perfect insight into those laws of life which regulate the introduction, increase and extermination of species. Geology teaches us that there is a power in nature which destroys not only individuals but even whole races. No doubt there is a power which, could man discover it, would enable him to slay the Wheat Midge, as it has in by-gone ages silenced for ever the Ichthyosaurus, the Mastodon, or any other of the buried thousands of the old lost worlds. It is not enough that a few men know at what season the Wheat Midge lays her egg, the time when that egg produces the worm-like larva, or when the pupa bursts to liberate the perfected insect, the parent of new swarms: all this has been for the last half century but a small item in the journal of the Entomologist; our only hope is to have thousands of observers of nature where there are now scarcely half a dozen; and surely when the vast interests depending upon the wheat crop are at stake, there is a sufficient reason to encourage the only science through which the means of saving it can be approached.

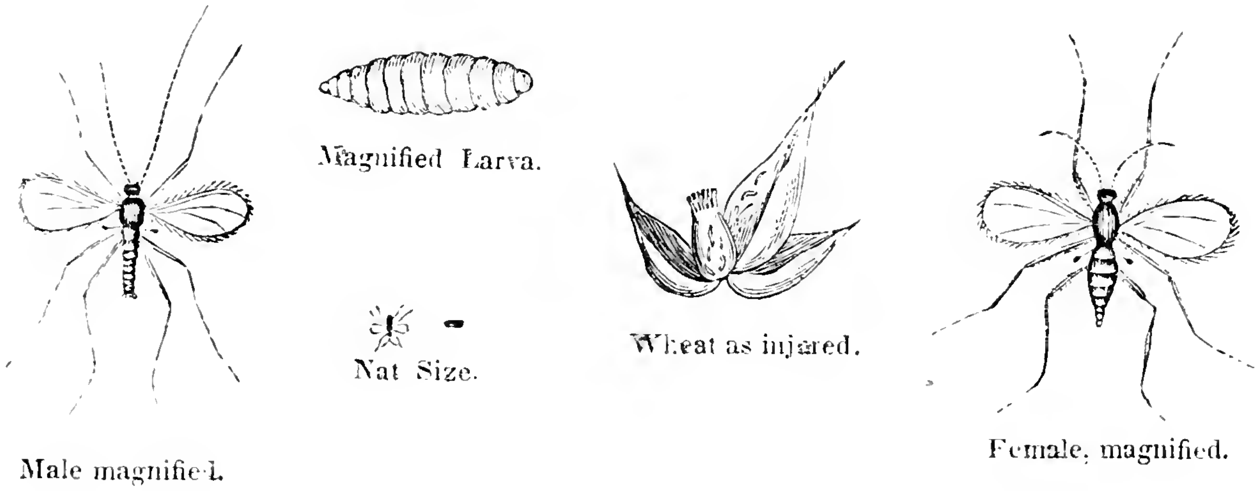
We regret that not having duly apportioned our space, much that we had prepared on this subject, together with some engravings already executed, must be excluded from the present number.

The following is from the Report of the Commissioner of Patents at Washington for the year 1854; Department of Agriculture.

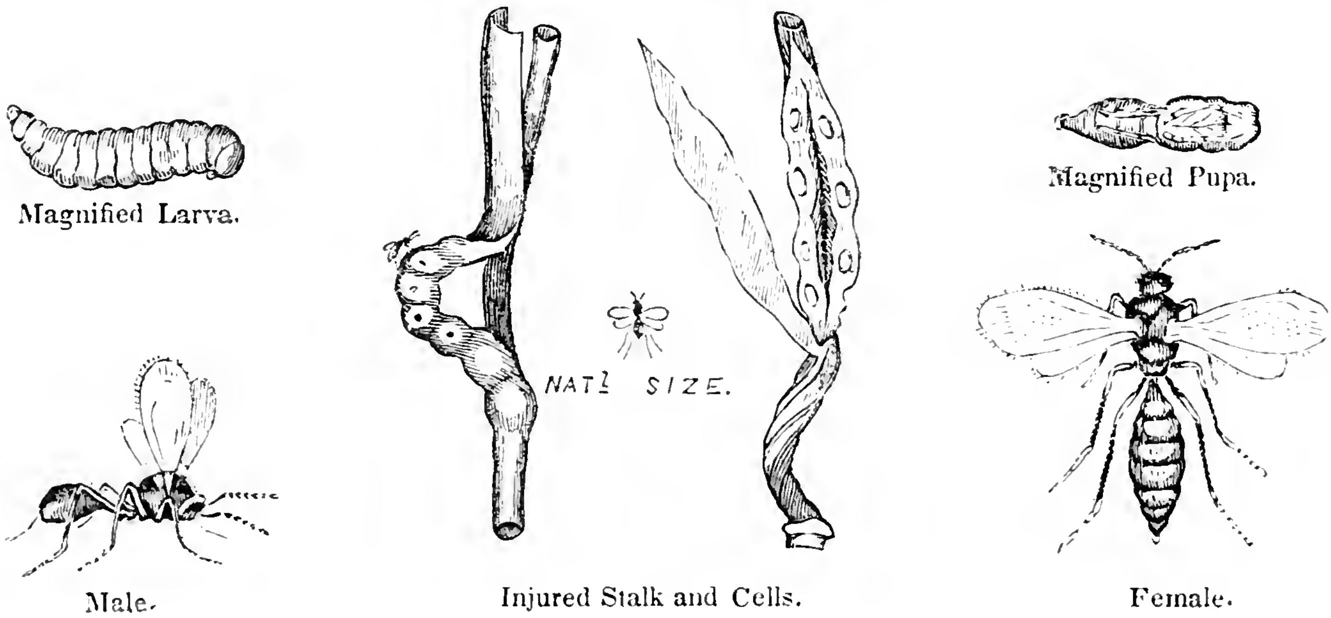
HESSIAN FLY.



WHEAT MIDGE.



JOINT WORM.



THE HESSIAN FLY.

"The following account of the Hessian Fly, (*Cecidomyia destructor*,) see plate, is condensed from Dr. Harris' Treatise on the Insects of New England, injurious to Vegetation. This insect was first observed in the year 1776, in the neighbourhood of Sir William Howe's debarkation on Staten Island, and at Flatbush on the west end of Long Island, New York. It is properly a small, two-winged gnat, which lays its eggs in winter or fall in wheat, when the grain has sprouted and begins to show leaves.

"According to the account of Mr. Edward Tilghman, of Queen Ann County, Maryland, the eggs are deposited in October, in the longitudinal cavities between the little ridges of the blade, from which, in about fifteen days, very small worms or maggots appear. They make way down the blades with considerable activity until hidden between them and the stems of the plants. Mr. Herrick, in the "Connecticut Farmer," says: "I have repeatedly, both in autumn and spring, seen the Hessian Fly in the act of depositing eggs on wheat. The number on a single leaf is often twenty or thirty, and sometimes much greater." The eggs are extremely minute, and of a pale red color; and if the weather prove favorable they will hatch in four days. The maggots, when they first come out of their shells, are also of a pale red color. Forthwith they crawl down the leaves and work their way between them and the main stalk, passing downwards till they come to a joint, just above which they remain, a little below the surface of the ground, with the head towards the root of the plant. Having thus fixed themselves upon the stalk, they become stationary, and never move from the place before their transformations are completed. They do not eat the stalk, neither do they penetrate within it, as some persons have supposed, but lie lengthwise on its surface, covered by the lower part of the leaves, and are wholly nourished by the sap, which they appear to take by suction. They soon lose their reddish color, turn pale, and will be found to be clouded with whitish spots, and through their transparent skins a greenish stripe may be seen in the middle of their bodies. As they increase in size and grow plump and firm, they become imbedded in the side of the stem by the pressure of their bodies upon the growing plant. One maggot thus placed seldom destroys the plant; but when two or three are fixed in this manner around the stem, they weaken and impoverish it, and cause it to fall down, or wither and die. They usually come to their full size in five or six weeks, and then measure about three-twentieths of an inch in length. Their skins now gradually harden, become brownish, and soon change to a bright chestnut color, which change usually happens about the first of December. The insect, in this form, has been commonly likened to flax-seed; hence many observers speak of this as the "flax-seed state." In two or three weeks after this change of color, the insect within becomes entirely detached from the old larva skin, and lies within it a motionless grub. The process of growth goes on, and some time after, on opening the leathery maggot skin, now a puparium, you find the pupa so far advanced that some of the members of the future fly are discernible through the scarf, which envelopes and fetters it on all sides. Within this shell, (the flax-seed case,) the pupa gradually advances to the winged state, until the end of April or beginning of May, when the flies make their escape by breaking through one end of the shell. The body of the Hessian Fly measures about the tenth of an inch in length, the head, antennæ, and thorax are black, the hind body tawny, more or less widely marked with black on each wing, and clothed with fine greyish hairs. The wings expand about a quarter of an inch or more, and are blackish, except at the base, where they are tawny and very narrow. They are fringed with short hairs, and rounded at the tip. The legs are pale red or brownish, and the feet black. The antennæ are jointed, and surrounded with whorls of short hairs. The flies, which come out in spring, lay their eggs on the leaves both of fall and spring-sown wheat. The maggots hatched from these, in New England, become stationary, and take the flax-seed state in June or July. They are generally transformed to flies in the autumn. According to Mr. James Worth, of Sharon, Pennsylvania, the second brood of flies, which appears early in June, has been entirely overlooked or confounded with the spring brood. He remarks that there are three complete broods, and partially a fourth in one season.

"The Hessian Fly is subject to the attacks of several parasitic insects, which serve more or less to lessen their numbers, the chief of which is the Ceraphron destructor, of Say, a shining black four-winged fly, about one-tenth of an inch in length. This fact is merely mentioned here, as it has often been mistaken for the true Hessian Fly, from being seen in wheat-fields in vast numbers, and known to come out of the dried larva skin of that fly, which, however, it had previously destroyed.

Mr. Herrick recommends that the stouter varieties of wheat should be chosen, and the ground kept in good condition. If fall wheat is sown late, some of the eggs will be avoided, but the risk of winter-killing will be incurred. Cattle or sheep, permitted to graze the wheat-fields during the fall will devour many of these eggs. Burning the stubble immediately after harvest, and then ploughing and harrowing the land, is also highly recommended. Steeping the grain, and rolling it in air-slacked lime or plaster, as promoting a rapid and vigorous growth, would also be beneficial.

THE WHEAT MIDGE.

"The Wheat Midge, (*Cecidomyia tritici,*) see plate, according to Dr. Harris, is a small yellow two-winged fly, very much resembling a mosquito in form, but much smaller in size. It is stated to have been first seen in America about the year 1828, in the northern part of Vermont and on the borders of Lower Canada. The parent fly deposits her eggs in the beginning of July, in the opening flowers of the grain, or when the wheat is still in the milky state. The eggs hatch in about eight days, when the little yellow maggots or worms may be found within the chaffy scales of the grain. The seed scales of grass also sometimes serve as a shelter for these depredators. The worms, which are of a bright yellow or orange color, do not exceed an eight of an inch in length, and are often much smaller. I have seen as many as twelve within the chaff of one single grain, sent to the Patent Office from Ohio. These maggots prey upon the wheat when only in a milky state. When they begin their depredations, soon after the blossoming of the plant, they do the greatest injury, as the grains never fill out. Towards the last of July or beginning of August, the full-grown maggots cease eating, and become sluggish and torpid, preparatory to shedding their skins, which takes place in the following manner: the body of the maggot gradually shrinks in length within its skin, and becomes more flattened and less pointed, as readily may be seen through its delicate transparency. This torpid state lasts only a few days, after which the insect casts its skin, leaving the latter entire, except a little rent at one end of it. These empty cases, or skins, may be found in great abundance in the wheat ears, after the moulting process is completed. Mr. J. W. Dawson,* of Pictou, Nova Scotia, says that sometimes the maggot descends from the plants and moults on the surface of the ground. After shedding this skin, it recovers its activity, and writhes about as at first, but takes no food. It is shorter, somewhat flattened, and more obtuse than before, and is of a deeper yellow color, with an oblong greenish spot in the middle of the body. Within two or three days after moulting, the maggots either descend of their own accord or are shaken out of the ears by the wind, and fall to the ground. They do not let themselves down by threads, as has been supposed by some, for they are not able to spin. Nearly all of them disappear before the middle of August, and they are rarely found in the grain at the time of harvest. Hon. William D. Lindsley, of Sandusky City, Ohio, however, sent me several specimens of wheat with this insect in it as late as the beginning of August. From observations and remarks made by intelligent farmers, it appears that the descent of these insects is facilitated by falling rain and heavy dews. Having reached the ground, the maggots soon burrow under the surface, sometimes to the depth of an inch, those which have not moulted casting their skins before entering the earth. Here they remain without further change through the following winter. It is not usually before June that they are transformed to pupæ, this change being effected without another moulting of the skin. This pupa state lasts but a short time, a week or two at most, and in many cases only a few days. Under the most favorable circumstances, the pupa works its way to the surface before liberating the included fly, and when the insect has taken wing, the empty pupa

* Now Principal of the University of McGill College, Montreal.

shell, or skin, will be seen protruding from the ground. In other cases, the fly issues from its pupa skin in the earth, and comes to the surface with flabby wings, which soon expand and dry on exposure to the air. This last change occurs mostly in the months of June and July, when great numbers of the flies have been seen apparently coming from the ground in fields where grain was raised the year before.

"The Wheat Midge, or Fly, "is a small orange-colored gnat, with long slender pale yellow legs, and two transparent wings reflecting the tints of the rainbow, and fringed with delicate hairs. Its eyes are black and prominent; its face and feelers yellow; its antennæ long and blackish. Those of the male are twice as long as the body, and consist of twenty-four joints, which, except the two basal ones, are globular, surrounded by hairs, and connected by slender portions like beads on a string. The antennæ of the female are about as long as the body, and consist of only twelve joints, which, except at the base, are oblong-oval, somewhat narrowed in the middle, and surrounded by two whorls of hairs. These insects vary much in size. The largest females do not exceed one tenth of an inch in length, and many are found towards the end of the season less than half this length. The males are usually rather smaller than the female, and somewhat paler in color." Mr. Lindsley sent several of these insects to the Patent Office in August last, and stated that they have been extremely destructive in several parts of his district last year, (1854,) and that in some places the cattle where turned into the field in order to eat the straw and what little was left of the grain, the main crop not being worth the trouble and expense of harvesting. These flies are likewise said to be much more numerous and destructive on the edges of fields than in the centre, and in some cases when the edges were completely worthless, the centre bore comparatively a good crop.

" Fumigation with sulphur and burning weeds on the windward side of the field, when the grain is in blossom, has been recommended. Air-slacked lime or wood ashes, strewn over the grain when in blossom, in the proportion of one bushel of lime or ashes to be scattered over the field when the plants are wet with dew or rain. Two or three applications have sometimes been found necessary. Ploughing up the ground also to destroy the maggots, and the dust-chaff, or refuse straw, if found to contain any of these insects, should be immediately burned. In those parts of New England where these insects have done the greatest injury, according to Dr. Harris, the cultivation of fall-sown or winter-grain has been given up, and this for some years to come will be the safest course."

THE JOINT WORM.

"The Joint Worm, (*Eurytoma hordei,*) see plate, now committing such ravages in the wheat fields of Virginia, is a small, black, four-winged fly, about an eighth of an inch in length. The female lays several eggs in the outer sheath of the stalk, above the joints. After they hatch, the worms commence feeding within the sheath, and the constant irritation produced by them forms a woody gall, or rather succession of galls, in the cavity of each of which lies a small footless maggot, about the seventh or eighth of an inch in length, having a body with thirteen segments, and of a pale, glossy, yellowish color. The number of worms in each cluster of galls varies from four to ten, or even more. The substance of the stalk attacked becomes brittle, and either partially or entirely fills its central cavity, and frequently distorts it into various irregular shapes. I have often observed young rootlets putting out immediately below a joint thus affected. The worms on the stalks of wheat, when examined in February last, were yet in the larva, but early in March several had assumed the pupa state. They were about an eighth of an inch in length, of a pale yellow color, which, as the pupæ were near coming out, became afterwards nearly black. These pupæ had the rudiments of wings, legs, and antennæ, as in the perfect fly, but were motionless. Late in April and the beginning of May, the flies made their appearance through holes gnawed through the tough woody covering of the gall-like excrescence in which they had passed the winter. This transformation, however, took place in a warm room. These flies are about an eighth of an inch in length, of a black color, the knees, joints, and feet, being tinged with yellow. The males, according to Dr. Harris, vary from the females by being smaller, and in having no piercers. The joints of the antennæ are likewise longer, and surrounded with whorls of little hairs. The hind body is shorter, less pointed at the extremity, and is connected with the thorax by a longer stem. He also says that among fifteen females only one male was found. This corresponds with what I have observed, as out of sixty to eighty Joint Worm Flies, produced from diseased stalks of wheat, I only procured one male, answering to his description, and eight parasites not quite a tenth of an inch in length, of a dark metallic shade, with yellow legs, and the antennæ much thicker at the end. These flies were furnished with four transparent dotted wings. If the small insect figured in the plate is the male, it is somewhat incomprehensible how it happens that so many females appear at the same time without more males.

"Another four-winged fly also made its appearance from the same stalks, of about an eighth of an inch in length, with an abdomen and legs of a bright yellow. The head and thorax were of a dark color, and somewhat metallic lustre. The wings were transparent, dotted, and fringed with short hairs, and the piercer reached to the middle of the under part of the abdomen.

"Dr. Harris states that it has been found in Massachusetts, that ploughing in the stubble has no effect upon the insects, which remain alive and uninjured under the slight covering of earth, and easily make their way to the surface, when they have completed their transformation. A free use of manure and thorough tillage, by promoting a rapid and vigorous growth of the plant, may render it less liable to suffer from the attacks of the insect. It has been stated that this fly, like the wheat midge, does more injury on the edges of the fields than in the middle.

" At the Joint Worm Convention, held at Warrenton, Virginia, in 1854, the following was recommended : prepare well the land intended for wheat, and sow it in the beginning of autumn, with the earliest and most thrifty and hardy varieties, and do nothing to retard the ripening of the crop, by grazing or otherwise. Use guano or some other fertilizer liberally, particularly when seeding corn-land or stubble. Burn other harbors of vegetable growth, contiguous to the crop. Sow the wheat in as large bodies, and in compact forms as practicable; and, if possible, neighbors should arrange amongst themselves to sow adjoining fields the same year. Feed all the wheat, or other straw, which may be infected, in racks or pens, or on confined spots; and in April set fire to all refuse fragments about the racks; and on or before the first of May carefully burn all the straw which has not been fed. The refuse of wheat, such as screenings, &c., should also be destroyed, as the pupa case is hard, and not easily softened by dampness or wet."

ARTICLE XLVI.—*Description of Fossils occurring in the Silurian Rocks of Canada.*

A gentleman walking upon the sea shore saw crawling on the hard sandy beach, a creature of extraordinary form, which had been left dry by the receding tide, and which was groping about as if seeking to find the waters again, its natural element. Its form was somewhat like that of a huge spider, with a number of flexible legs that bent beneath its globular body as if unable to sustain the weight. As our friend became greatly interested in its figure and movements, he seized it, fancying he had captured a prize, but soon found that he had " caught a Tartar." The strange beast suddenly wound its legs around his arms and held him fast with prodigious force, as if bound with so many strong cords. So powerful was the grasp of these organs, and so tenaciously did they retain their hold, that before they could be removed it was necessary to cut them away with a knife.

This sea monster was a Cuttlefish, belonging to the class Cephalopoda, " animals, says a modern Naturalist, distinguished by most strange and paradoxical characters, and exhibiting forms so uncouth that the young Zoologist, who for the first time encounters one of these creatures, may well be startled at the anomolous appearance presented by beings so remote in their external construction from everything with which he has been familiar.

"Let him conceive an animal whose body is *a closed bag* containing the viscera, connected with digestion, circulation and reproduction, furnished with a head and staring eyes; that upon the head are supported numerous and complex organs of locomotion used as feet or organs of prehension; moreover, that in the centre of the locomotive apparatus, thus singularly situated is a strong and sharp horny beak, resembling that of a parrot; and he will rudely picture to himself a Cephalopod."

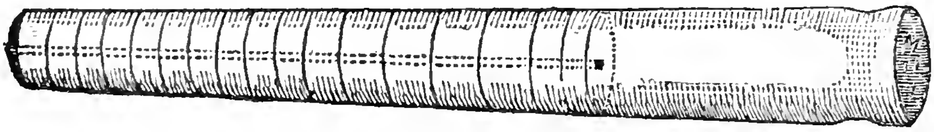
The Cuttlefishes are organized for a purely predacious life, and their structure is such that no animal of their own size can be entangled in their arms without almost a certainty of destruction. The body in some of the species is nearly as round as a ball; in others it is flattened and elliptical, while in many species it is elongated or cylindrical, having the mouth surrounded with its circle of arms at one end. The arms are strong, perfectly flexible, and with the whole of their inner surface covered with suckers which adhere to whatever object the animal attaches them, with such force that they will tear away the piece of flesh to which they are fastened rather than relinquish their hold. "If, says the distinguished Naturalist whom we have above quoted, the Poulpe but touch its prey it is enough: once a few of those tenacious suckers get firm hold, the swiftness of the fish is unavailing, as it is soon trammelled on all sides and dragged to the mouth of its destroyer; the shell of the lobster or of the crab is a vain protection, for the hard and crooked beak of the Cephalopod easily breaks to pieces the frail armour; and even man himself, while bathing, has been entwined by the strong arms of gigantic species and struggled in vain against a grasp so pertinacious." *

The Cephalopoda are divided by Professor Owen into two orders, the DIBRANCHIATA, having two gills, and the TETRABRANCHIATA, with four gills. Of the last mentioned order there is only one species, the celebrated Nautilus (*Nautilus Pompilius,*) known to be living in the whole world. Yet in the fossil state there are more than 1400 species whose remains have been found in the various formations. Here we have an instance of the almost total extermination of not merely a species or a genus but of nearly a whole order of animals. No doubt the Nautilus itself will in course of time cease to exist, and then the order TETRABRANCHIATA will no longer have a living representative upon earth.

* Thomas Rymer Jones: General Outline of the Animal Kingdom; 1st Ed., page 432.

The remains of the most ancient tribes of the Cephalopoda are exceedingly abundant in certain formations in Canada. The seas of the Silurian period, judging from the numbers of Orthoceratites found in the rocks of that age, swarmed with these creatures; they all belonged to the order *Tetrabranchiata.* The Dibranchiata, so powerful in the present oceans, did not come into existence until many ages had elapsed after the Trenton limestone was formed. The most common fossil Cephalopoda in Canada are the Orthoceratites, an ideal figure of one of which is here given.

b



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c

Fig. 1. *An Orthoceratite.**

In order to understand the above figure, the reader will please recollect what we have stated concerning the organization of the modern Cuttlefish. Its body consists simply of a fleshy bag, in some species of a globular shape in others cylindrical and having the head and arms at one end. The object above figured is a long straight shell, open at one end at the letter *a*, and closed at *b*. The space from *b* to *c* is divided into a number of compartments by an equal number of transverse plates of shell, or *septa* as they are called. These all communicate with each other by a tube represented by the dotted lines along the centre. This tube is called the siphuncle. From *c* to *a* is a space undivided and constituting a single large chamber, which contained the body of the animal. We have only to imagine the body of a modern Cuttlefish placed in the large chamber from *c* to *a*; and with its head and legs or arms protruding from the mouth of the shell at *a*, and we shall have formed a tolerably correct idea of a living Orthoceratite.

Certain species of those creatures in the ancient seas were of a great size. In the collection of the Geological Survey at Montreal, there are numerous specimens of the shells, which when perfect must have been ten feet in length. Their arms may have been of a corresponding length, and as the ocean swarmed with them, bathing (had there been anybody in those remote ages to bathe) would have been a dangerous recreation.

* Copied from the "Bulletin de la Société Géologique de France, Tome 12, Planche V.

These remains are quite common in the Silurian rocks of Canada, and wherever a river has worn away the loose soil, and in low water leaves a few yards of flat rock bare, the remains of Orthoceratites may be seen. In some of the species the siphuncle was composed of a number of more or less globular divisions, and in such instances, where it is seen imbedded in the stone, it bears a certain resemblance to the back-bone of a fish. The rings of the siphuncle represent the joints, and the septa the ribs, and they are often mistaken for the remains of vertebrated fishes, although none of that department of animated beings existed in the Silurian seas. Many of the species were of diminutive size, in fact mere pigmies when compared with some of their gigantic brethren. Two of these we shall figure in the present article, leaving the discussion of the others for the next number of this periodical.

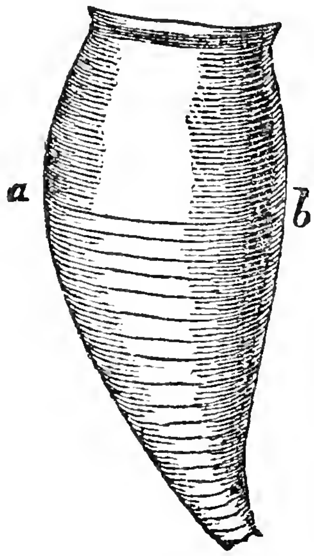


Fig. 2.

Fig. 3.

Fig. 2. *Oncoceras constrictum.*—Hall.

Fig. 3. *A section across Oncoceras constrictum, at the upper chamber from a to b.*

The word Orthoceratite is derived from two Greek words: *orthos*, straight, and *keras*, a horn, meaning literally a straight horn. The Orthoceratites are all straight. The word *Oncoceras* is from the Greek *onkos*, a bending or protuberance, and *keras*, a horn. The fossil of which the word is the generic name is not quite straight but curved, as above represented in Fig. 2. The largest are scarcely four inches in length. They are usually found in the condition of casts or moulds of the interior, the tubular shell having been destroyed. These casts shew all the septa, and the form of the large chamber in which the body of the animal was contained. This species is slightly curved, ventricose in the middle, the greatest diameter being at the base of the upper chamber. Near the mouth there is a constriction in the casts caused by the thickening of the shell at this place. The septa are very thin and nearly flat. The siphuncle is very small, and situated close to the dorsal or convex side at the point *a*. The dorsal side is not so much rounded as the ventral, consequently a section across the fossil from *a* to *b* is elliptical, as seen in Fig. 3. In Fig. 3, the position of the siphuncle is indicated at the point *a*. The fossil tapers very rapidly to a point from the outer chamber. The ventral side is the straightest. Specimens with the outer shell preserved are covered with fine striæ which are slightly flexuous on the dorsal side.

This interesting little species was first described by Professor Hall, and as it differs from all other known generic forms of the great family of Orthoceratites, he constituted a new genus for its reception with the following characters: GENUS ONCOCERAS, "tube curved; aperture constricted; lower part of the outer chamber and upper part of the septate portion, ventricose; abruptly contracting towards the apex; siphuncle small, dorsal; septa plane, nearly flat, slightly elevated on the dorsal margin."

ORTHOCERAS BILINEATUM.—Hall.

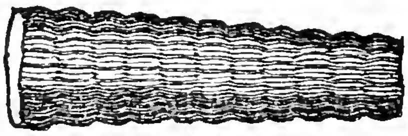


Fig. 4. *Portion of Orthoceras bilineatum.*

We may add that specimens in the collection of the Geological Survey of Canada shew that the aperture of *Oncoceras constrictum* was elliptical, and that the constriction seen in the casts as before stated is caused by the thickening of the shell near the aperture, forming an internal ring at this part of the tube.

The specific name is Latin, *constrictus*, narrow or constrained. We have collected specimens of this species at the "Little Chaudiere Rapids, Pauquettes Rapids, and at the City of Ottawa. It appears to be most abundant in the lower part of the Trenton limestone, in the beds reposing directly upon the Black River limestone.

Fig, 4 is also an Orthoceratite which is never seen of a great size. The largest specimen we have observed is about eight inches in length, and scarcely an inch in diameter at the aperture. The form of the species is straight, cylindrical, slender and gradually tapering. The shell is characterized by slightly arched or undulating rounded annulations, distant from each other about two fifths of the diameter of the tube. The surface is marked from one end to the other by sharp longitudinal elevated lines, a finer line between every two of the coarser ones; we have never seen the septa of this species, and cannot say how near they are together. The siphuncle is near the centre.

This species is found at the localities given for *Oncoceras constrictum*. The specific name is from the Latin *bis*, twice or double, and *lineatus*, the participle of the verb *lineo*, to draw lines.

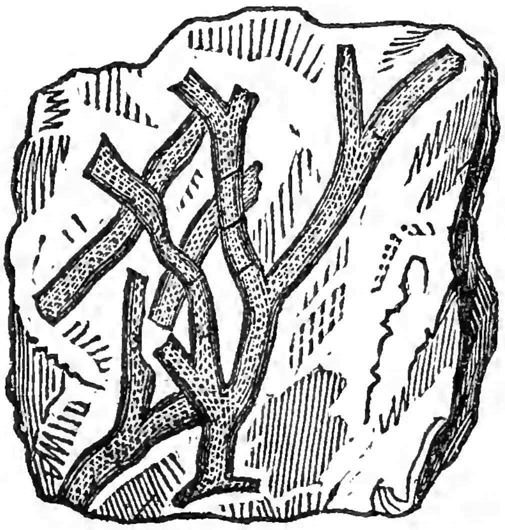
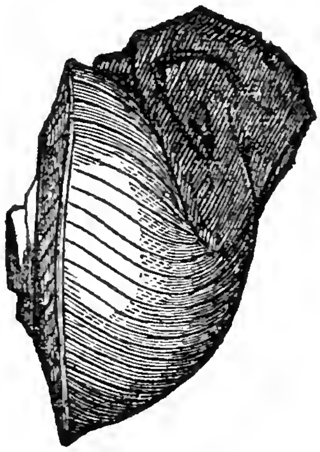


Fig. 5.—*Ptilodictya acuta.*

Stictopora acuta.—Hall.

The genus Ptilodictya consists of thin leaf-like fossils, branched, and with both surfaces set with numerous small ovate cells. These and other fossils of several allied genera have until recently been considered to be corals. They are now, however, thought to be the remains of animals which belonged to the department of the Mollusca. There are many species in the existing seas, and they are characterized principally by their mode of growth. The ordinary Mollusca consist of individuals free and separated from each other, each one leading an independent existence; but in the *Bryozoa*, (Greek, *bruon*, sea moss, and *zoon*, an animal,) as they are called from their moss like growth, great numbers grow together, forming twigs, leaves or plant-like objects, or encrusting in thin layers, shells and stones on the bottom of the sea. Concerning their structure, little can be said in this place. Each one of the minute cells to be seen in the fossils is the cavity once occupied by the viscera of a single Bryozoon. Minute as these animals are, yet each individual of the recent species is found to possess a mouth surrounded by about twelve tentacula covered with vibratile cilia, or exceedingly fine hair like filaments, which by their constant motion cause currents in the water, and assist in capturing food. The food passes from the mouth into a gizzard, whence after having been comminuted, it is conveyed into an elongated stomach, and there digested. From the stomach an intestine proceeds to the surface, and opens near the mouth of the animal, serving to discharge the undigested portion of the food.

Ptilodictya acuta, the most abundant Bryozoon of the Trenton limestone, is represented by Fig. 5, copied from the first vol. of the Palæontology of New York. The branches are about one eighth of an inch in width, and from one to four inches in length. They are flat and rather sharp at the edges. There are from six to ten rows of cells. A narrow pace on the edge of each branch is without cells.



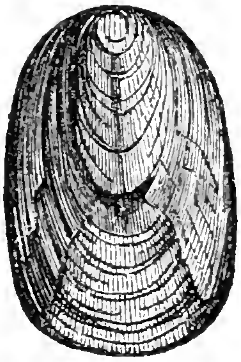


Fig. 6. Fig. 7. Fig. 8.

Fig. 6. *Raphistoma staminea.*—Hall. *View of the top of the shell.*
Fig. 7. *Raphistoma staminea. View of one side.*
Fig. 8. *Lingula quadrata.*

Ptilodictya is from the Greek *ptilon*, a wing, "more especially a membraneous wing as that of an insect," and *dictuon*, a net, *acuta*, Latin, sharp, in allusion to the sharp edges of this species. It was called *Stictopora* by Professor Hall, from *stictos*, spotted, and *pora*, a pore, but it is now thought to belong to the first named genus. It is common in the Trenton limestone, and also in rocks of the same age in Wales.

Figs. 6 and 7 represent a fossil found in the Chazy limestone. In general shape it somewhat resembles a Pleurotamaria, but it is nearly flat above, and covered with striæ across the whorls, which are interrupted along the centre of the upper part of the whorl by a concentric elevated line, as seen in Fig. 6. Good specimens of this fossil are rare.

The generic name is from the Greek *raphe*, a seam or suture, and *stoma*, a mouth, from the suture or seam like appearance in the upper side of the aperture.

The specific name appears to be from the Latin *stamineus*, made of threads, or full of threads, thready, probably having reference to the thread-like striæ on the surface of this fossil.

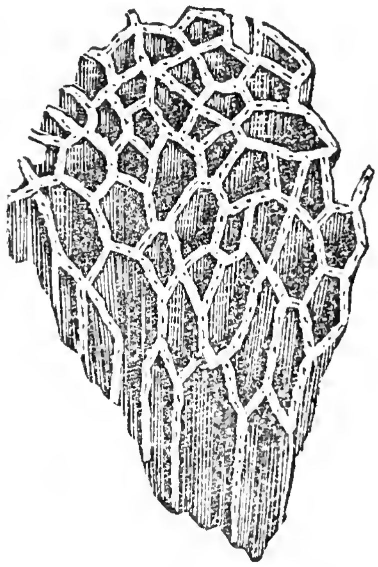


Fig. 9.

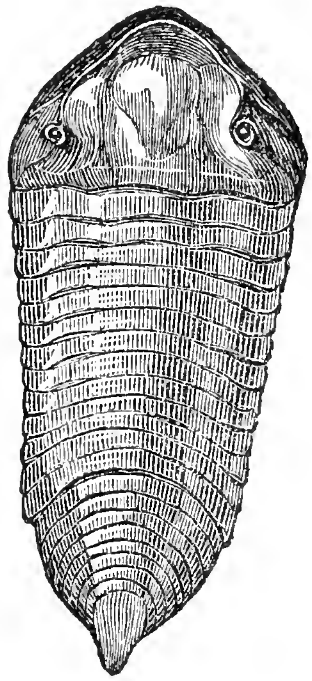


Fig. 10.

Fig. 9. *Halysites catenulates*, or *Catenipora escharoides*.
Fig. 10. *Homolonotus delphinocepalus*.

Lingula quadrata, Fig. 8, is one of the largest fossils of this genus known. Its length is about an inch, its sides nearly parrallel, extremities rounded, and the surface covered with strong concentric striæ, with longitudinal striæ extending from the top to the bottom. It occurs in the Trenton limestone and Hudson River group, and is found in the lower Silurian rocks of Europe. The specific name, *quadrata*, has allusion to the somewhat four sided shape.

The chain coral, *Halysites catenulatus*, is one of the most common of the Silurian fossils both in Europe and in America. It consists of numerous irregular vertical plates joining together so as to form an easily recognized net-work upon the surface of the rock. The edges of the plates contain the numerous cell cavities of the polyps. These are small, oval, and varying in size from one half a line to one line in length.

Halysites is from the Greek *halysion*, a small chain or necklace, and *lithos*, a stone ; *catenulatus*, Latin, from *catena*, a chain, or *catella*, a small chain ; *catenopora*, from the Latin *catena*, a chain, and the Greek *pora*, a pore ; *escharoides*, from the Greek, *eschara*, a gridiron.

Homolonotus delphinocephalus.

This trilobite has thirteen segments in the thorax and in the caudal shield or tail, eleven to thirteen in the central lobe, and from seven to nine in each of the lateral lobes. The head is ovate or sub-triangular; the tail is also sub-triangular and pointed at the extremity; each one of the articulations of the body has a groove running nearly its whole length near the front margin. The surface is rough and granulated. This is one of those species trilobites the central lobe of whose body is scarcely definable, the articulations being without the sharp bend on each side the centre, which constitutes the middle lobe in many other species. The glabella, or that portion in the centre of the head which is usually elevated in the trilobite, has in this species very little if any prominence. The eyes are small. The facial suture, as described by Professor Hall, is parallel and coincident with, or slighty within, the flexure of the margin (in front,) passing thence obliquely through the eye, and turning comes to the margin a little above the posterior angle. It abounds in the Niagara formation and also in the Wenlock limestone in England.

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BY E. BILLINGS.

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ARTICLE XLVII.—*On the Tertiary Rocks of Canada, with some account of their Fossils.*

The Tertiary Rocks of Canada are supposed to consist of two divisions, the "Glacial Drift," or simply the "Drift," so called because its materials have been either wholly or in part transported or drifted from the north, and the Lawrencian Formation, which takes its name from the St. Lawrence, it being extensively developed in the valley of that stream. The glacial drift is also known by the name of the "Boulder Formation," on account of the great number of boulders or loose blocks of stone it contains.

The drift constitutes the principal portion of those vast beds of clay, sand, gravel and loose stones that may be seen almost every where, not only in Canada, but also spread out over all the northern regions of Europe, and a part of Asia. Of all the geological formations this is the most remarkable, and although more universally diffused than any other in those countries where the science has been brought to the greatest degree of perfection, yet there is no system of rocks concerning the precise nature of whose origin so much doubt remains. It appears to have been produced by operations of nature very different from those under the influence of which the more ancient rocks were accumulated. The regular strata, that may be seen in all the quarries and cliffs of the ordinary sandstones and limestones, the perfection of the organic remains they contain, and the homogenous texture of the consolidated materials, prove that these are nothing more than the beds of sediment quietly, and during long periods of time, deposited on the floors of the oceans, and afterwards, by some process of petrifaction, converted into solid stone. But the drift, on the other hand, presents evidence of having been formed during a season when a force of some kind, not yet ascertained to the satisfaction of all investigators, was applied to the northern portion of the planet in such a manner as to grind down the surface, and transport the fragments southward. The real character of that force has been made the subject of a vast deal of discussion, and although it has for many years engaged the attention of the ablest men of the civilized world, yet it may be safely said that no theory has yet been advanced which explains all the phenomena. To those who have not studied the subject this will appear the more remarkable, when it is added that there is abundant proof that the formation is one of the most recent of all, its date being immediately before the creation of the existing species, so that the unsettled state of the problem places the Geologist in this unpleasant predicament, that while he can boldly and truly answer for events that occurred myriads of ages before the advent of his race, yet when questioned concerning that which comes almost within the period of human history, he must confess his inability to give any but a conjectural reply. That such should be the case, however, is no discredit to the science, but rather a proof that the principles already adopted are the results of mature deliberation.

As there is scarcely a square mile of the surface of Canada where some portion of the drift cannot be examined, the opportunites for studying it are abundant, but the most favorable localities are where deep excavations have been made for railway or canal purposes. In such places the lower portion of the deposit may be seen to consist of a confused mass of rounded stones of every size, from that of a small pebble to a huge boulder, weighing several hundreds of tons. These are usually imbedded in a tough clay, and sometimes so cemented together as to require the aid of blasting in order to proceed with the work. The boulders are many of them of the same kind of rock as that which exists in the neighbourhood, while a large proportion consist of materials only known in some distant part of the country. These latter are more rounded than the former, a consequence of the rough usage they have received during their transportation from the parent bed. The drift is often overlaid by beds of clay or sand, containing a few or no boulders; but where this is not the case, and the drift constitutes the surface, then the farmer who owns the field will find himself greatly annoyed by the innumerable round stones that impede his plough. From such fields the boulders may all be removed from the surface, and after a few years a fresh crop will take their place, having worked up from the deposit of drift below, which extends downwards to the solid rock. Stoney fields are so common in Canada that they are not usually looked upon as objects of curiosity; and yet the question of how the stones came there is the most curious one in the science of geology. If it could be proved that they were created on the spot where we now find them, there would be an end of the question; but then the more a person examines them, the more convinced he will feel that they have been transported from some locality more or less distant. It is not our purpose to enter into all the proofs, but we shall mention a few of the most striking evidences that boulders are what they appear to be, and are often called travelled stones.

It has been already mentioned in this journal in several places, that the Lawrencian Rocks occupy the northern frontier of Canada, while a broad stripe all along the southern margin, from the mouth of the St. Lawrence to Lake Huron, is underlaid by the Silurian and Devonian Formations, only concealed from view by the drift which, with a slight admixture of vegetable matter, constitutes the ordinary agricultural soil of the country. The principal exception is between Brockville and Kingston, where the Lawrencian Formation comes down from the north, and crosses the St. Lawrence into the State of New York. Were a person to journey from the east towards the west along the base of the Lawrencian hills, he would have continually upon his left hand the flat country, underlaid by the sandstones, limestones and shales of the fossiliferous formations, and occasionally he would see places where these are laid bare, and abut against the gneissoid rocks which constitute the hills. He would also soon observe that the flat floors of limestone or sandstone which terminate at the base of the mountain are encumbered by fragments of rock identical in composition with that of the precipice, and the proof that they had been broken off and rolled down to their present position would be sufficiently convincing to satisfy any reasonable mind. But let him turn towards the south, and travel away from the hills across Canada, and proceed several hundred miles into the United States, and he will be able to trace fragments of the same rock, in the shape of more or less rounded boulders, the whole distance. It will be observed also that towards the south they are smaller and much more worn than they are near the point of their departure, a necessary consequence of the greater length of their journey. The States of New York, Ohio, Pennsylvania, Michigan, Illinois, and in fact all the country north of the Appalachian Mountains are covered over with boulders that have travelled from the Lawrencian regions, across Upper Canada and the great lakes. That these rocks have been transported from the north towards the south is almost self evident, from the facts that they rest upon fossiliferous strata, and also, that no rock of the same kind exists in any place in the Western States, but only in the northern regions.

The same formation occurs not only in this country but in the north of Europe and Asia, and also in the southern hemisphere. In fact, the drift surrounds both the north and the south poles of our planet, while in the tropical regions there is a broad belt completely encircling the earth, where no drift is found. Sir Charles Lyell states, of the European drift, that, "In tracing this remarkable deposit through the borders of the Baltic, we sometimes find fragments of rock which must have travelled hundreds of miles from their point of departure; and as a general thing, we find that they grow larger in size as we approach the region from which they were derived. This I found to be the fact in going north from the margin of the Rhine to Holstein and Denmark, where I found fragments of Scandinavian Rocks, from Sweden, nine and sometimes forty feet in diameter; and at last, the whole country was made up of these rocks."* The rocks to which he alludes have all been transported bodily across the Baltic Sea.

* Lyell's Lectures on Geology, page 49.

In Switzerland, thousands of huge blocks of granite have been transported from one ridge of mountains to another, across the wide and deep valley that separates them, with so little injury that their angles are not at all worn. This is the most remarkable of all the known localities of erratic stones. The Alps are here separated from the Jura Mountains by a distance of 30 miles between their bases, but the distance between the highest points of these two chains is 80 miles. The Jura is of secondary limestone, and yet upon its slopes, 800 feet above the level of the lake of Neufchatel, which lies in the valley below, there is a long line of granitic blocks extending for miles, and consisting of a material only found in the distant chain of the Alps. Professor Forbes states of these, that "wherever seen they fill the mind with astonishment, when it is recollected that as a matter of certainty these vast rocks, larger than no mean cottages, have been removed from the distant peaks of the Alps, visible in dim perspective amidst the eternal snows, at the very instant we stand on their debris. The most notable of these masses, called the *Pierre à Bot* (or Toad Stone,) lies in a belt of wood not far from a farm house, about two miles west of Neufchatel, and near the road to Vallengin and La-Chaux-de-Fonds. The first height above the lake being gained, (vine clad on its lower slopes,) we come rather abruptly upon a small cultivated terrace, where the farm house just mentioned is situated. This hollow in the hill permits some accumulation in the soil, which elsewhere is very thin and bare. Immediately behind, however, the hill again rises, covered with thick wood, in every part of which not a few, but hundreds and thousands of travelled blocks may be found. Some small and rounded, but a vast number exceeding a cubic yard in contents, and perfectly angular, or at least with only the corners and edges slightly worn, but without any appearance whatever of considerable attrition, or of any violence having been used in their transport. Indeed such violence would be quite inconsistent with their appearance and present position.

"The dimensions of the *Pierre à Bot* are 50 feet long, 20 wide, and 40 high, containing 40,000 cubic feet (French.) It froms a stupendous monument of power. It is impossible to look at it without emotion, after surveying the distance which separates it from its birth place. No wonder that Geologists have vied with one another in attempting to account for so extensive and surprising a phenomenon."*

* Professor J. D. Forbes' Travels through the Alps, page 49.

In Canada we have never seen boulders at all comparable for their size with the stupendous blocks here mentioned as occurring in Europe. Fragments from ten to fifteen feet in diameter are often met with, but we know of no instance at all approaching the magnificent dimensions of forty feet long, and fifty feet high. This may be in some measure due to the fact that there is very little granite in the regions where our boulders had their origin. The rocks are there stratified, and it would be almost impossible to find a mass of any great size that would not be easily separated into numerous thin pieces corresponding to the thickness of the strata. Perfectly coherent strata, fifty feet thick, must be rare; but granite, not being stratified, may form much larger boulders. M. A. Archiac, in his history of the progress of Geology, says that "A block of granite on the calcareous mountain near Orsières contains more than 100,000 cubic feet. Above Mouthey, many blocks derived from the Val de Fernet, and which have thus travelled a distance not less than eleven leagues, contain from 8,000 to 50,000 and 60,000 cubic feet. One of the blocks of granite near Seeberg measures 61,000 feet, and has travelled about sixty leagues." In the Eastern States, where granite is more common, the boulders are larger than they are in Canada. Professor Hitchcock mentions one in New Hampshire which was thirty feet in diameter, and another that measured one hundred and fifty feet in horizontal circumference.

In Mr. Murray's Report for 1844, he thus describes the drift of that part of the Province which came under his observation during that year:—"It cannot but have struck every one who has travelled over the western part of Canada, that nearly the whole of it is very much covered and concealed by a vast deposit of soft or loose derivative material, and it is only where the country is intersected by rivers, or on the lake shores, or in that mountain ridge which extends from Queenston to Hamilton, and thence to Nottawasaga Bay on Lake Huron, that an outcrop of the older stratified rock is to be seen.

"In the district which has on the present occasion been more immediately the subject of my investigation, the deposit consists of various beds of clay, sand and gravel, interspersed with large boulders; the thickness it attains is generally very considerable, and frequently reaches 200 or 300 feet. The clay cliffs of Scarborough are 320 feet; the central bridges, as they are called, running parallel to the north shore of Lake Ontario, are probably

200 or 300 feet; and the highlands in Oxford are frequently 100 or 200 feet, and even more; and the banks of the Grand River often expose a very considerable amount.

"As to the sources whence the material is derived, the finer parts, considered by themselves, present less evidence than the coarser; the clay gives no evidence at all. In some portions of the sand, however, magnetic iron ore exists, as on the shore of Lake Ontario at Toronto, where the quantity is so considerable on Gibraltar Point, that if a magnet be thrust into the arenaceous detritus comprising it, on being withdrawn it will be found covered with small grains of the ore. The origin of this is probably the primary region where magnetic iron ore abounds. The evidence of the gravel and coarser material is more direct. The calcareous pebbles in the country on the south shores of Lake Simcoe are identical with the limestones of Rama, to the north, and their fossil, as well as their minerological character, is an incontestible proof of the source from which they are derived. The testimony of fossils is brought to bear also in the district of country separating Lake Ontario from Lake Erie, and by them it is readily determined that the coarser detritus reposing upon each successive formation, is made up, with the addition of whatever is of primary origin, of material derived from the formation itself, or of the ruin of some lower deposit whose outcrop is to the north, or of a mixture of both. The ruins of southern outcrops never repose on northern formations for great distances, and only occasionally for short ones, where the southern outcrop occupying an elevated position in an escarpment, the northern deposit stands at a lower geographical level. Instances of this last condition may be seen on the flank and at the base of the ridge skirting the south side of the lake, where fragments of the Niagara limestones, which constitute its summit, may frequently be found resting on the red marls lower down. But on the contrary, high up the side of the mountain, in the same range, 110 feet above the lake level, often may be encountered the remains of the subjacent blue shales, whose outcrop is buried either beneath the waters of the lake or must be looked for on the opposite shore; and though the fragments of this individual formation may not extend to the margin of Lake Erie, the detritus resting there upon the upper limestones consists chiefly of their own debris, with that of the gypseous series to the north. The great erratic blocks or boulders, when rounded by distant travel, are almost all of primary origin, and the evidence they present is in unison with that derived from the gravel and sand, to prove that at some remote period the surface has been covered with water having a current from the north.

"As bearing upon the probable direction of this current, it may be mentioned that in several places between Niagara and Hamilton, along the mountain or ridge which has been alluded to, where the drift has been removed, the rock beneath has been found to present a smooth and almost polished condition, with a gently undulating surface, marked by deep parallel grooves and scratches, whose general direction is from north to south. These grooves are well displayed in the quarry of Mr. Kifler, at Thorold."*

The smoothing, polishing and grooving of the rock surfaces are phenomena intimately connected with the origin of the drift, and present so many different features that it has been found impossible to devise any one theory that would account for them all. Where the drift is removed, and the surface of the solid rock laid bare, it is found to have been almost everywhere subjected to a grinding process, as if an immense sheet of sand paper had been drawn over the country from the north towards the south. Sometimes flat surfaces of limestone several acres in extent will be found in part polished like a looking glass, but usually furrowed by long parallel scratches, as fresh in appearance as if they had been made but yesterday. In places where the strata are tilted up, so that their edges project, these will often be found planed down to an uniform level. Where mountains or low hummocks of rock have been subjected to this process, the striæ are often seen to pass up the slope and over the summit. In such cases it is always the north side of the mountain that has received the polish, while the southern extremity remains untouched, thus affording another proof that the whatever it was that produced the scratches or polish moved from the north towards the south. In geology the abraded end of the mountain is called the strike side, and the other the lee side. On any good recent exposure of these glacial striæ, the observer will be instantly struck, not only with their freshness, but also with their exact parallelism. In different parts of the country their direction is also different, but in the same neighborhood they follow the same course, even over

* Report on the Progress of the Geological Survey of Canada, 1844, by Alexander Murray, Esq., Assistant Geologist.

the summits of the hills. Sometimes two sets of striæ may be seen on the same surface, crossing each other at a small angle; but in such instances, all the lines belonging to each will be parallel. The hard parts of the rock are ground down to the same level with the soft, as if they had been rasped with a file of steel; and further, thousands of boulders may be seen thrown out of new excavations, which are covered with similar scratches.

It is generally believed that in each section of the country the direction of the glacial striæ is the same as that in which the boulders of the neighborhood have proceeded. Dr. Bigsby, a gentleman who travelled over a large portion of British North America some years ago, states, in a paper read before the Geological Society of London in 1851, that boulders have been carried from the Mountain of Montreal up the valley of the St. Lawrence. "It is curious," he says, "to trace the well marked angitic trap of Montreal, stretching up the St. Lawrence, and occurring at successive distances, until the last bit I observed was on the Genesee River, on the south shore of Lake Ontario, 270 miles to the south-west. The boulders of this rock are, however, in far greater quantity on the southern levels between Montreal and Lake Champlain."*

On the map which accompanies Dr. Bigsby's paper, he has laid down a line extending from the rear of the Island of Montreal, across the Isle Perrot, through the northern part of the State of New York, the Thousand Islands, and Lake Ontario, to Rochester, as the direction in which the boulders have travelled. We are not aware that this line was drawn with reference to any glacial striæ observed by him; but very recently, in the cutting of the Grand Trunk Railway on the Isle Perrot, we had an opportunity of observing the striæ where the Potsdam sandstone has been laid bare. Their course is there about north-east and south-west, which corresponds very nearly with the line on the map. Another proof that the course of the drift was up the St. Lawrence, may be seen, we think, at the north-west corner of the Mountain of Montreal, at Côte St. Antoine, where a long ridge of drift runs south-west, pointing in the direction of Lachine and Caughnawaga. This line would be about parallel with the other, but several miles further south. It is found that where a mountain of rock like that at Montreal stands alone in the midst of a

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*Bigsby on Canadian Erratics—Quarterly Journal of the Geological Society, vol. 8, page 234.

level plain, the strike side, or that which was exposed to the current, has been swept clean, while the lee side has a long ridge of drift stretching away from it. Such mountains are called "crag and tail," and from the little we have seen of the hill in question, we think it affords a good example. The Barrack Hill, at the City of Ottawa, is another, but with the tail turned towards the south-east, extending in a line running from the old military hospital in the direction of the canal basin.

The courses of the glacial striæ in the valleys of the Ottawa and St. Lawrence, so far as we have observed them, are at right angles to each other. On the Barrack Hill, in the City of Ottawa, at the village of New Edinburgh, at Stegman's Rapids, on the Rideau, five miles from Ottawa, near the first toll-gate on the road to Aylmer, in the Township of Hull, and also in the Township of March, we have seen them, and in all these localities their course is from the north-west towards the south-east. Further up the Ottawa, on the road between the village of Renfrew and Burnstown, and also in the Township of Ross, they have the same bearing. It thus appears that while the glacial stream ran down the valley of the Ottawa it flowed up the St. Lawrence, a state of things which would lead to one more of those complexities which have so long made the question of drift the most unsettled one in geology.

Where these striæ are found in valleys bounded on each side by shores of rock, they often follow the windings of the ravine as if it had been the channel of a stream. A remarkable instance of this fact was observed by Sir W. E. Logan, while examining the geology of the upper part of the Ottawa. Under the head of "*Glacial Action*," he states :—" Fresh water shell marls occur in many places in the alluvial deposits of the Ottawa, and among the phenomena which come within the recent period, rounded and polished rock surfaces, bearing parallel grooves and scratches, are of not unfrequent occurrence. They were met with on the Gatineau, half-way between Farmer's and Blasdell's mills, where the direction of the scratches is about S. 36° E.; on Glen's Creek, in Pakenham, where they are about N. and S.; on the Allumettes Lake, at Mongomery's Clearing, where they are S. 25° E.; but on the shores of Lake Temiscamang they are so numerous, and are combined with other circumstances of so marked a character, as to deserve particular notice. The lake has already been described as long and narrow. Its banks are in general bold and rocky, rising into hills 200 to 400 and sometimes 500 feet above its surface, with the exception of the mouths of several transverse valleys occuring on the left bank, among the slates, sandstones and limestones on the north side of the anticlinal axis. The general valley of the lake, thus bounded, presents several gentle turns, the directions connected with two of which, reaching down to the mouth of the Keepawa River (thirty-five miles) are 158°, 191°, 156°, numbering the degrees from north as zero round by east. The parallel grooves in these reaches of the valley turn precisely with their bearings, and they are registered on various rounded and polished surfaces projecting into the lake, and sometimes rising to thirty and forty feet over its level. It was not easy to follow them to higher surfaces, for these usually were covered with the moss and trees of the forest, but they were occasionally traced to spots where they thus became concealed. These projecting points never were found to deflect the grooved lines in the slighest degree, and one remarkable instance of this occurs on the east side of the lake about a mile above the lower large island, at the south horn of a pretty deep bay. The rock belongs to the slate conglomerates, and it is composed of pebbles and boulders of igneous origin. Its face is a clean, smooth, rounded surface cutting through the pebbles, which are polished down with other parts. It is very deeply grooved with parallel furrows in the bearing 160°, and from the water's edge they run obliquely up the face (an inclined plane of 60° in an upward direction of 102°,) and continue on in the same bearing of 160° on the rounded or rather flattened top, thirty-five feet above the lake; so that whatever body moving downward in the valley may have caused the grooves; it was not deflected by meeting with a surface, presenting a thirty-five feet height of front, so steep as 60°, notwithstanding it impinged upon it at an angle of no more than 32°. On the summit of the rock there is another set of parallel grooves, not so deeply marked, which cross the former at an acute angle, the bearing being 185°. In another place, about six miles higher on the lake, on the same side, a polished surface, not over four or five feet above the water, belongs to the very base of the limestone formation. Vast boulders and fragments of the sandstone below lie in a calcareo-arenaceous cement, some of the imbedded circular slices or half boulders being nine feet in diameter, while in some parts the solid sandstone strata are seen, and great cracks or worn fissures in them are filled with cement.

The rock, in short, is a collection of great boulders and blocks of sandstone, which were lying immediately on the strata from which they were derived, when they became enveloped by the succeeding formation. The whole is planed to a smooth tesselated surface, and marked with parallel grooves. In the same vicinity, the parallel grooves occasionally appear on the flat surfaces of successive steps, formed by one layer of sandstone resting on another. They, however, do not always come up to the vertical sides of the steps, and these ungrooved parts are usually rough and uneven, as if they had but recently been fractured or deprived of their protecting cover. The Company's post stands on a point on the east side, which cuts the lake nearly in two, at about eighteen miles from the head, and it is opposite a less prominent point on the other side. These points approach to within a quarter of a mile of one another. Both are composed of sand and gravel, which on the east form a hill 130 feet high. The southern face of this hill runs in the bearing 65°, and the gravel towards the eastward rests on flat sandstone strata, which have a smooth and partially rounded surface. The gravel and the rock constitute the north side of a deep bay. The polished rock surface exhibits well marked grooves, which come from beneath the gravel hill, nearly at right angles to the margin of the water. There is here, as in some other instances, more than one set of parallel scratches. Two of these sets cross one another in the directions 140° and 196°. The gravel may once have been continuous across the lake, and may have been broken or worn down for the escape of the water, which now flows past in a gentle current through the gap. The mass is not unlike the remains of an ancient moraine, and, combined with the smooth rounded surfaces and parallel grooves and scratches, and the changes in their direction, the circumstances of the case may well suggest that this part of the valley of the Ottawa may have been the seat of an ancient glacier. A difficulty appears to stand in the way of the hypothesis, in the horizontality of the valley. There is little fall in it for seventy miles, and the total height of the lake above the sea is only 612 feet. What descent there may be in the valleys which lead into it on the north, having their origin in the watershed, about forty-five miles distant, in which the ice behind might press on the ice before, has not yet been ascertained, but it is not reported to be very great. But as Professor J. D. Forbes appears to have demonstrated, in his Travels through the Alps, that in glaciers there is a flow, the particles of ice moving on one another, it must be the fact that uncounterpoised superincumbent pressure from unequal accumulation would be a perfectly good cause of movement, and thus the horizontality of the valley would be no difficulty. In the eastern bay at the head of the lake, near the mouth of the Otter River, parallel grooves were remarked running in the bearing 105°, which is the upward direction of the valley of that stream; and about a mile westward of the Blanche in the same bay, in the bearing 130°, partaking of the direction of the valley, bounded by the escarpment of the limestone described as running back into the interior. The discrepancy between these bearings and those lower down is considerable, but being in the general direction of valleys joining the main one, the grooves may be the result of tributary glaciers. It has already been stated that accumulations of boulders, gravel and sand are met with in several parts of the river lower down, occasionally so obstructing its course as to produce rapids. Some of these may owe their origin to the same causes which have produced the gravel hill of Fort Temiscamang. It is scarcely necessary to remark, that the present effects of ice on the lake appear wholly inadequate to account for even those parallel furrows least removed above its level, though it may sometimes produce results analagous, but less important and uniform. On the east side of the lake, three boulders were remarked which had been moved by the ice of the previous winter. One of them, measuring thirty-two cubic feet, had been moved nine feet in the direction 90°; another, one hundred cubic feet, had been moved fourteen feet in the direction 350°; another, eighty cubic feet, had been moved fourteen feet in the direction 35°; each had left behind it a deep broad furrow through the gravel of the beach down to the clay beneath. In front of the first was accumulated a heap of gravel, one foot high, with an area of nine square feet; and in front of the second was an accumulation of small boulders, weighing from 80 to 100 lbs. each. To move the second and third, the progress of the ice must have been up the lake, and the first across it. Had the gravel rested on a surface of rock instead of clay, parallel scratches would have been the result in each case." *

The fact that in valleys the glacial striæ upon the rocks follow the windings of the channel has also been confirmed by numerous

* Sir W. E. Logan's Report of Progress of the Geological Survey of Canada, 1846.

observations in the United States and in Europe. In addition to this it can be shewn that in some districts where there are groups of high mountains the boulders have travelled in all directions away from one of these hills, which is therefore called a centre of dispersion. We have not ascertained that any such centres exist in British North America, although they have been found in the Eastern States. These centres of dispersion must be regarded as mere local phenomena, confined to comparatively small tracts of country, while the glacial drift, in its widest sense, appears to have been a grand process, extending its operations over the whole northern hemisphere, in a continuous sheet, flooding the earth, sweeping along huge boulders from the north towards the south, and scouring, polishing and grinding down all the formations over which it passed.

THEORIES OF THE DRIFT.—The theories that have been devised in order to account for the phenomena of the drift are principally the following:—Some Geologists have supposed that in consequence of a great subterranean convulsion the bottom of the sea at the north pole was suddenly elevated, and the superincumbent waters caused to rush violently southward over the continents, dashing among the hills, tearing up rocks, and carrying the ruins along with them in their tumultous career. This, we believe, is called the "*debacle* theory," and the flood caused by the elevation of the sea-bottom, the "the *debacle* or wave of translation."* The objections to this theory are that while it is purely hypothetical, there is, besides, evidence that the work of polishing and grooving rock surfaces appears to have been a slow operation, instead of a rapid and violent one. It is evident that the worn and completely rounded condition of the greater number of the boulders must have been produced by the long continued action of water. A disturbance that could only continue for a few days, or while the wave was passing over the continent, must have been utterly incompetent to produce even a tenth part of all the phenomena that may be observed in connection with the drift.

In a work published in Paris in 1844, (*Etudes sur l'Histoire de la Terre*,) the author, M. de Boucheporn, accounts for the erratic blocks of Europe by supposing a sudden displacement of the axis of the earth, in consequence of which the North Pole was brought to take a position in the neighborhood of the Baltic Sea, somewhere near and north of Prussia or Poland. But as

* From the French *débâcle*, the breaking up of a frozen river.

this theory would not account for the drift of America, he supposes a second displacement, whereby the pole was removed to the vicinity of the City of Boston, in the United States. Great quantities of ice and snow accumulated in Europe and America during these periods, which on the return of the pole to its present position melted, occasioning great floods, which dispersed the boulders and spread the drift over the land. The theory which has received the greatest amount of respect is that which attributes the drift to vast glaciers that covered a large portion of the Arctic and North temperate regions, and by their continual flow towards the south, shoved along or otherwise transported the boulders and debris of which the drift is composed. This theory was suggested by observations made among the Alps, where, in those mountains covered with perpetual snow, the ravines that descend their sides are full of ice, which moves or rather flows down—for this glacier ice is not solid, but in a viscid state—with exceeding slowness, bearing upon its surface or embedded in it masses of rock of all sizes, which it deposits on the plains below. These glaciers polish the solid rocks over which they pass in a manner similar to the polishing and grooving referred to in the drift of this and other countries. This theory has for its supporters some of the most distinguished philosophers of the age, among whom may be mentioned Professor Agassiz. It is called the Glacial Theory, and supposes a period of extreme cold, during which the Antarctic climate was experienced so far south as the present United States.

The "Iceberg Theory," much advocated by Sir Charles Lyell, has also many very eminent men for its supporters. According to this view, during the period of the drift, the northern portions of the present continents of Europe and America were submerged beneath the ocean, but to no great depth, and the boulders were transported by icebergs floating from the north towards the south. These bergs in their course rubbed along the bottom, and while they polished the rock surfaces, the stones imbedded in the ice occasioned the long parallel grooves and scratches which may be seen wherever the drift is removed. That the icebergs of the present day do carry boulders, gravel, sand and clay, which have become attached to them while in contact with the northern sea coasts, is a well established fact. Their course in the Atlantic is always towards the south, and when they enter the warm climates of the sea, they melt away, and drop the boulders and other materials with which they are freighted, to the bottom. Should the bed of the ocean between America and Europe become dry land, there is not the least doubt but that we should find it strewn over with blocks of stone, much in the same way as our fields are strewn. This theory has many able advocates, but still it does not satisfy all.

The Lawrencian Formation.—What is considered to be the true drift lies at the bottom of the mass of loose material which covers Canada, and consists of clay, sand, gravel and boulders, broken from every formation, and mixed confusedly together in one common ruin; but above this, there are in many extensive tracts of country regularly stratified beds, which appear to have been quietly deposited, and which also contain organic remains of species identical with those now living in the Gulf of St. Lawrence and northern seas. This deposit occupies the vallies of the St. Lawrence and Ottawa, and consists of fine clay, sand and gravel, which generally make a good and fertile soil. While it was in the course of being deposited, there can be no question but that all Canada, east of Kingston, was submerged beneath the ocean. At the same time, the sea was tenanted by a considerable number of the same species of marine animals that are now to be found in it. The late Professor E. Forbes, in an elaborate and beautiful memoir "on the geological relations of the existing Fauna and Flora of the British Isles," gives a list of 174 species of animals whose remains have been found fossil, either in the drift of Europe or the Lawrencian deposit of America; and since that paper was published (1846) many other species have been found. He thus classifies them :—

Mammalia	5
Pisces	1
Mollusca	155
Cirrhipeda	5
Annellida	3
Echinodermata	2
Zoophyta	2
Plantæ	1
	174

The Mammalia of this list are altogether of the whale tribe; the single species of fish to which he alludes is the common

Capelan of the Gulf of St. Lawrence, first found fossil in Canada at Green's Creek, in the Township of Gloucester, near the City of Ottawa, and taken to England by Sir W. E. Logan, who afterwards discovered another species, the Lumpsucker (*Cyclopteris lumpus*,) in the same locality. Of the Mollusca mentioned in his list, about twenty species have been found in the Lawrencian deposit of Canada, some of which we shall figure in this article. The identity of so many species with those of Britain, and even with those of the elevated sea-beds of Sweden, still further from us, appears to prove that England, Scotland, Ireland, together with Canada, and much of Northern Europe, were under water at the same time.

The line between the drift and the Lawrencian formation does not appear to us to be very distinctly marked. This latter deposit contains boulders imbedded in it, and upon its surface are often to be seen some of the largest blocks. At the village of Renfrew, in the county of Renfrew, we have seen two species of fossil shells, *Saxicava rugosa* and *Tellina Grœnlandica*, the latter in great abundance in a stratified bed of gravel, above which there were numerous very large boulders. In this place, we can see at one glance both the transported rocks which characterise the drift, and also the stratification and organic remains, considered to be marks of the Lawrencian rocks. Above the fish bed at Green's Creek, and in the same clay with these remains, there are boulders, and in many other places the same phenomena may be observed. We have never, however, discovered any fossils in the lower part of the deposit, or what is especially termed the drift. If the iceberg theory be the true one, then the whole subject may perhaps be explained by supposing that during the commencement of the the glacial epoch the seas of America were but sparsely or not at all inhabited, and that towards its close the bottom descended to a depth so great that the gradually accumulating beds of clay and sand could no longer be disturbed and commingled by the passing ice, while at the same time they would receive the boulders dropped as the icebergs melted away. But as we have already made this article too long, we shall for the present withhold any further remarks upon the subject, only recommending such of our readers as have not done so, to examine the drift for themselves, and in good excavations they will find much to reward them for their investigations. The principal facts may be thus summed up :

1. Canada, and the greater portion of the continent north of 40° of north latitude, is covered over with a deposit consisting of clay, sand, gravel and broken stones, the ruins of all geological formations mixed confusedly together.

2. The lower part of this deposit is unstratified, and constitutes what is called the "drift," while the upper portion is distinctly stratified, consists of materials which appear to have been accumulated during a period of less violence, and contains organic remains. This part of the deposit is called the Lawrencian. West of Kingston, the formation is not known to contain marine remains, although, in other respects, it is similar to that lying in the country east to the mouth of the St. Lawrence.

3. The rock beneath the drift is smoothed, polished and grooved with long parallel scratches.

4. There is some evidence to induce the belief that the boulders have travelled in the direction of the grooves in the rocks.

5. There is some evidence to shew that from the Island of Montreal the drift moved north-westerly up the St. Lawrence.

6. We have also some proof that it moved in the upper part of the Ottawa in a general direction from north-west to the south-east, down the valley of the Ottawa, and in a direction at right angles to the drift of the St. Lawrence.

7. Although in certain districts the course of the drift has been either towards the east or west of south, yet upon the whole, it has moved southerly, except in the neighbourhood of high mountains, where local centres of dispersion have been ascertained.

The above summary contains the principal facts, but there are many other phenomena connected with the events of the period of the drift, such as the river and lake ridges and terraces, the conveying of rocks from lower to higher levels, and others of an analagous nature, of which we may hereafter give some account.

The following are some of the fossils most frequently found in the Lawrencian deposit of Canada :

Fig. 1. *Saxicava rugosa.*—This little shell varies much in its form, and belongs to a group of species not easily distinguished from each other on account of these variations. This species is, however, the only one of the genus found fossil in Canada, and may be easily recognised by its elongated shape and rough concentrically striated exterior. It is a member of the family of LITHOPHAGIDÆ, or "stone-eaters," so called on account of the wonderful faculty they possess of boring holes in rocks, where they permanently

locate themselves. "Mr. Sowerby remarks that they are frequently found on the outside of oysters, protected by their irregularities, and in the clefts of rocks or corals, roots of sea-weeds, and perforating oysters, chalk, limestone and hardened clay." It is living, according to Professor E. Forbes, "in all the seas of Northern and Arctic Europe, Northern America and Greenland. It ranges as far south as the Canary Isles. Its vertical range is very great. In the British Seas, it is found abundantly in the laminarian and coralline regions. In the Mediteranean, it has been observedalive at all depths between twenty and eighty fathoms."*

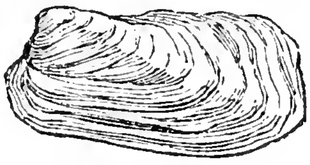

Fig. 1.

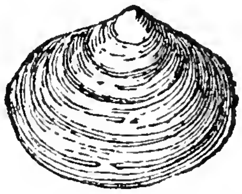

Fig. 2.

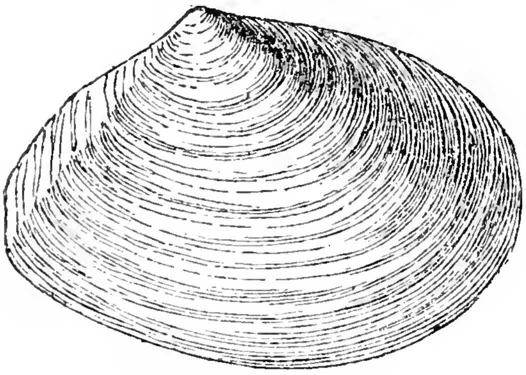

Fig. 3.

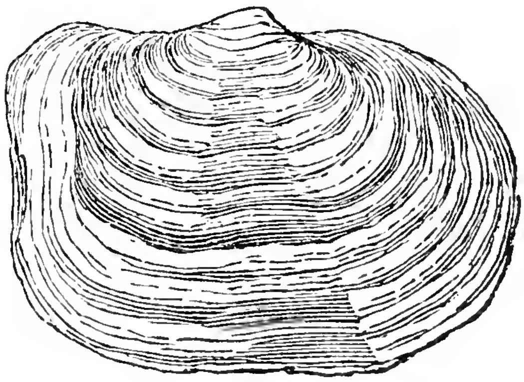

Fig. 4.

Fig. 1.—*Saxicava rugosa.*
Fig. 2.—*Tellina Grœnlandica.*
Fig. 3.—*Tellina calcarea.*
Fig. 4.—*Mya truncata.*

In Canada it is found fossil in very numerous localities over all the valley of the St. Lawrence and the flat country south of the Ottawa. On the mountain of Montreal it occurs at a level of more than 400 feet above the St. Lawrence. Along the base of the mountain we have seen it at the brick-yard near the toll-gate, St. Lawrence Street, near McGill College, at several places on Sherbrooke Street, and at Côte St. Antoine. The most astonishing locality, however, is at Beauport, three miles from Quebec. There is

* Forbes, in Memoirs of Geological Survey of Great Britain, vol. 1, page 410.

here a bed about ten feet in thickness composed of nothing but shells of *Saxicava rugosa*, with scarcely any earth intermixed. It reposes upon other beds containing a number of other species in a deposit of gravel, with small boulders. The place may be found by going to the mill at Beauport and proceeding up the creek about 300 yards, where the cliff will be seen nearly white from the profusion of the shells it contains.

Professor Forbes says: "It occurs in all the Irish, Scotch, and English fossiliferous drifts and glacial clays," and in the upraised lands of Sweden it is also abundant, in association with other species found with it in Canada. *Saxicava*—Latin, "*saxum*," stone, and "*cava*," to excavate; "*rugosa*," rough.

Fig. 2. *Tellina Grœnlandica.*—This little shell occurs in nearly all the localities of *Saxicava rugosa*. It is at present living in Arctic seas, and according to Capt. Bayfield, in the Gulf of St. Lawrence. The generic name is from the Greek, "*telline*," a kind of mussel. It is said that there are 200 species of Tellina living, and 130 fossil in all the formations from the oolite upwards.

Fig. 3. *Tellina calcarea.*—Living in the Arctic seas, Behring's Straits and Greenland; fossil at Beauport, Montreal and numerous other localities in Canada, also in Scotland and Russia. *Calcarea*, (Latin,) pertaining to lime.

Fig. 4. *Mya truncata.*—This is a thick strong shell, easily recognised by the abrupt truncation of one of its extremities. One of the valves has on the inside, immediately beneath the umbo, a remarkable projection called the cartilage process. There is another species, *Mya arenaria*, about the same size, but not truncated, also found fossil in Canada. "The Myas frequent soft bottoms, especially the sandy and gravelly mud of river mouths; they range from low water to 25 fathoms, rarely to 100 or 125 fathoms. *Mya arenaria* burrows a foot deep; this species and *Mya truncata* are found throughout the northern and Arctic seas, from Ochotsk and Sitka to the Russian Ice Meer, the Baltic, and British coast; *in the Mediterranean they are only found fossil.* They are eaten in Zetland and North America, and are excellent food. In Greenland they are sought after by the walrus, the Arctic fox and birds."* Both these species are living in the Gulf of St. Lawrence; fossil at Beauport, Montreal, &c.

Mya, a mussel; *truncata*, cut off; *arenaria*, pertaining to sand.

* Woodward's Recent and Fossil Shells, page 317.

Fig. 5. *Astarte Laurentiana.*—This species was first found by Sir Charles Lyell at Quebec, or among shells procured there. It is not known to be living in any sea, and is perhaps extinct. It may be recognized by the very regular concentric ridges which cover its surface. Occurs at Beauport and Montreal. *Astarte*, the name of a goddess of the Sidonians and Assyrians, called in Scripture, Ashtaroth.

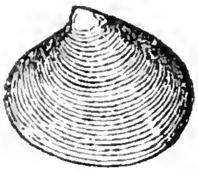

Fig. 5.

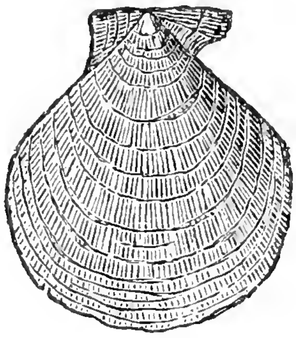

Fig. 6.

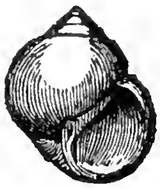

Fig. 7.

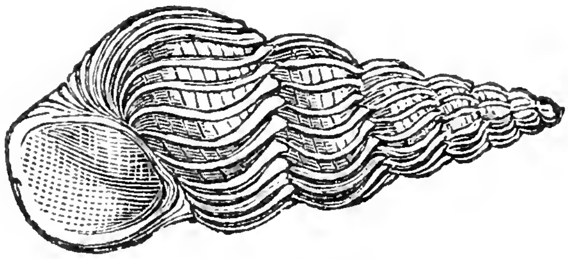

Fig. 8.

Fig. 5.—*Astarte Laurentiana.*
Fig. 6.—*Pecten Islandicus.*
Fig. 7.—*Natica clausa.*
Fig. 8.—*Scalaria borealis.*

Fig. 6. *Pecten Islandicus.*—The Pectens, or Scallops, have the power of swimming through the waters. Woodward, page 257, says:—"The Rev. D. Landsborough observed the fry (young) of *P. opercularis*, when less than the size of a six-pence, swimming in a pool of sea water left by the ebbing of the tide. Their motion was rapid and ziz-zag; they seemed, by the sudden opening and closing of their valves, to have the power of darting like an arrow through the waters. One jerk carried them some yards, and then by another jerk they were off in a moment on a different track." There are 120 species living, and 450 fossil, from the carboniferous upwards.

P. Islandicus inhabits the Atlantic from Nova Scotia to Greenland. It occurs fossil at Beauport. Some of the specimens are four times the length of the one figured. Occurs fossil in Russia and Sweden. *Pecten*, a comb; *Islandicus*, Iceland.

Fig. 7. *Natica clausa.*—This little shell is rather plentiful in the deposit at Beauport, and is also found fossil in the Scottish, Manx, Irish and north of England glacial beds. It is living in the Arctic Seas and Gulf of St. Lawrence. At Beauport, numerous specimens of Tellina and Mya may be collected, with small circular holes drilled through them. According to Gould, (Invertebrata of Massachusetts, p. 232,) these perforations have been made by a Natica, probably this species. They are carnivorous, "and have the power of perforating shells, it is generally supposed, by discharging an acid which decomposes the shell, and through the aperture they extract the juices, and destroy the lives of the otherwise secure inhabitants. Their foot is large, so as completely to envelope the objects on which they prey. In moving, they burrow in the sand, so as to be almost entirely concealed by it, and their place is generally indicated by a small heap of sand." *Natica*, probably from *nato*, to swim or move with a fluctuating motion; *clausa*, from *clausus*, shut up or inclosed.

Fig. 8. *Scalaria borealis.*—Belongs to the celebrated family of *Wentle-traps*, once so highly prized by shell-collectors, that one hundred guineas has been paid for a single specimen of a favorite species, the Royal or Precious Wentle-trap, *S. pretiosa*. The species of this genus live in from 7 to 80 fathoms in sandy mud. *S. borealis*, living in the Arctic Seas; fossil at Beauport and in Sweden. *Scalaris*, like a ladder; *borealis*, northern.

Fig. 9. *Buccinum undatum.*—May be recognized by the folds that cross the whorls; most prominent on the upper part of the whorl. It is also marked with "raised lines, from one-fifth to one-tenth of an inch apart, with minute intervening striæ." (Gould, p. 306.) In the fossil shells, the exterior often exfoliates so that these markings cannot always be seen. The protuberance on the left-hand side of the aperture in Fig. 9 does not occur on all the specimens. This shell is also called *Tritonium Anglicanum*. It once lived in the Mediterranean, but, as well as *Mya truncata*, has become extinct there,—a fact of great geological importance, as it proves that the sudden disappearance of a fossil from the strata of one country is no proof that it may not be found in a higher formation in another.

B. undatum inhabits the Atlantic from Cape Cod northwards. Fossil at Beauport, Montreal, and various other places in Lower Canada; also in Britain, Sweden and Russia. Name from *buccina*, a trumpet; *undatus*, waved. It is called a *whelk* in Britain. Our fossil is considered a variety.

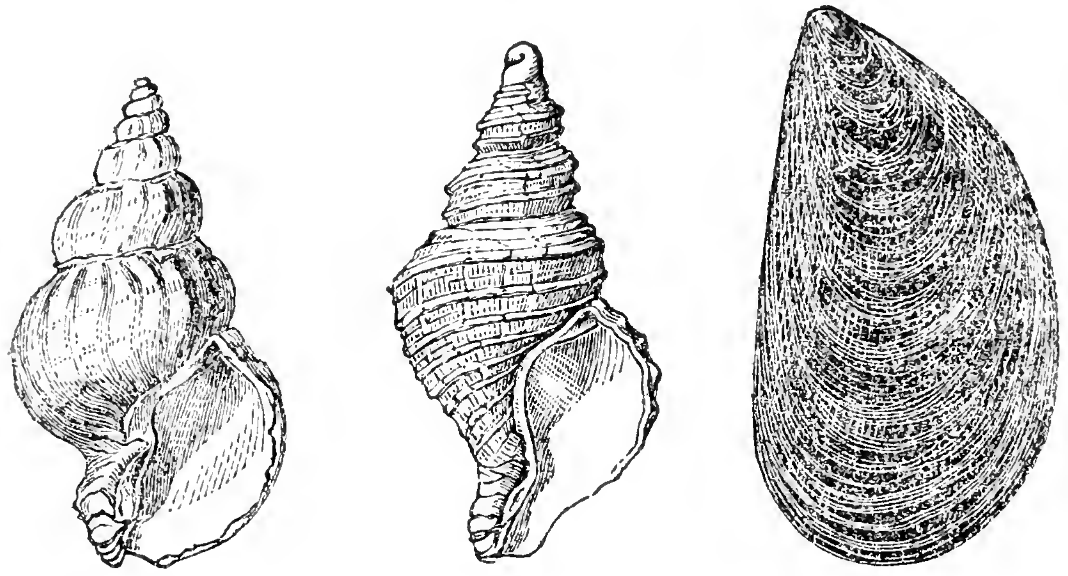

Fig. 9. Fig. 10. Fig. 11.

Fig. 9.—*Buccinum undatum.*
Fig. 10.—*Fusus carinatus.*
Fig. 11.—*Mytilus edulis.*

Fig. 10. *Fusus carinatus*, called also *Tritonium fornicatum*. —Living in the Gulf of St. Lawrence, Arctic Seas, Greenland; fossil at Beauport. *Fusus*, a spindle; *carinatus*, carinated, in allusion to the carinæ or keel-like ridges that wind round the shell, ascending spirally to the apex; these are more conspicuous in some specimens than in others.

Fig. 11. *Mytilis edulis.*—Fossil at Beauport, Montreal, &c.; living abundantly in the seas of Europe and America. The mussels, while living, are attached to rocks, sea-weeds, or other marine substances, by a flexible ligament like a bundle of fine threads, which issues from within outward, passing between the valves. This organ is called a byssus. Violent sickness is sometimes occasioned in Britain by eating the animal of this shell at certain seasons. There are 50 living and 80 fossil species. Some palæontologists are of opinion that the genus existed during the Lower Silurian period. *Mytilis*, (Latin) a mussel; *edulis*, edible.

Fig. 12.—*Terrebratula psittacea*, or *Rhynconella psittacea.*—This little fossil is interesting, because although the catalogue of the genus contains upwards of 250 species, ranging from the Lower

Silurian upwards through all the formations, yet only two are living at the present day, of which *R. psittacea* is one. The race is on the decline, and will perhaps soon become extinct. It belongs to the class Brachiopoda, so fully represented by the fossils of the lower Silurian rocks of Canada. At Beauport, where the specimen figured was procured, *R. psittacea* occurs plentifully at the base of the bed holding the *Saxicava*. Specimens may be procured there with both valves in connexion. Living in the seas of Newfoundland, Labrador, Greenland and Norway; fossil in the drift of Ayrshire and Bramerton, Scotland, and at Beauport, Canada.

Rhynconella, from the Greek, *rhynkos*, a beak; *psittacea*, from *psittacus*, a parrot. The other living species is *R. nigricans*, found in the seas of New Zealand.

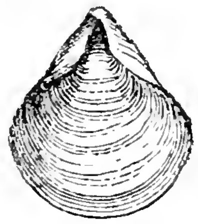

Fig. 12.

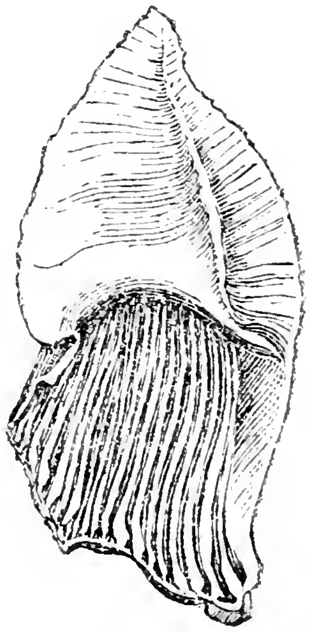

Fig. 13.

Fig. 12.—*Rhynconella psittacea.*
Fig. 13.—*Balanus Uddevallensis.*

Fig. 13. *Balanus Uddevalensis* is one of the loose valves of a large species of Balanus. These animals belong to the sub-kingdom Articulata, class Cirrhipeda. The fragments have a light grey or bluish colour, and are rather plentiful at Beauport. The living barnacles adhere to stones, floating pieces of wood, shell, fish, &c. In the Township of Gloucester, in the excavation made for the Ottawa and Prescott Railway, near Cunningham's Farm, many of the small boulders had the barnacles which lived in the

sea while Canada was beneath the waves still attached to them. *Balanus*, an acorn; Uddevalla is a town in Sweden, where this species is found not only fossil but living.

The above are the principal species found in the drift, and it should be remarked that many of them do not occur west of Montreal. *Tellina Grœnlandica* and *Saxicava rugosa* are the species most widely diffused, extending further inland than any of the others; *Mytilus edulis* and *Mya truncata* come next, having been found as far west as the City of Ottawa. East of Montreal, the species increase in number and individuals as we approach the ocean; west of Kingston no marine drift shells have been discovered. The following is a list of the Canadian fossils of the drift or Lawrencian periods:

1. *Whales.* Species not determined. There is part of a skeleton in the collection of the Geological Survey at Montreal. It was found in the clay near the city.

2. *Seals.* Species not determined. Green's Creek, Gloucester. Specimen's in collection of Geological Survey, Montreal. The bones of the posterior limbs found by Mr. P. A. McArthur, Ottawa, already figured in this journal.

3. *Mallotus villosus.* The common Capelan of the gulf, fossil at Green's Creek, and also at Flat Rapids, Madawaska River, County of Renfrew.

4. *Cyclopteris lumpus.* The lumpsucker, a fish common in the Atlantic, fossil at Green's Creek. It is said that these two species of fish are the only ones found, both in a living and fossil state.

MOLLUSCA.

5. *Buccinum undatum.*
6. *Fusus carinatus.*
7. *Trichotropis borealis.*
8. *Natica clausa.*
9. *Velutina* ——— ?———
10. *Scalaria Grœnlandica.*
11. *Scalaria borealis.*
12. *Littorina palliata.*
13. *Mya truncata.*
14. *Mya arenaria.*
15. *Saxicava rugosa.*
16. *Tellina Grœnlandica.*
17. *Tellina calcarea.*

18. *Astarte Laurentiana.*
19. *Cardium Grœnlandicum.*
20. *Cardium Islandicum.*
21. *Nucula sapotilla?*
22. *Mytilus edulis.*
23. *Pecten Islandicus.*
24. *Rhynconella psittacea.*
25. *Balanus miser.*
26. *Balanus Uddevalensis.*
27. *Echinus granulatus.*

In addition to the above in the nodules of indurated clay containing other fossils, there are found the leaves and twigs of trees, grass and weeds, shewing that land covered with vegetation existed at no great distance. These fossils, as a group, are supposed to belong more to an Arctic than a temperate climate, and in consequence, indicate a greater degree of cold during the latter part of the Tertiary than exists at present in Canada.

ARTICLE XLVIII.—*On the American Buffalo, (Bison Americanus.)*

GENUS BISON.

DENTAL FORMULA.

Incisive $\frac{0}{8}$; *Canine* $\frac{0}{0}$—$\frac{0}{0}$; *Molar* $\frac{6}{6}$—$\frac{6}{6}$ = 32.

According to Mr. Vassey, a writer upon the Ox Tribe, the Buffalo differs somewhat from the common ox (*Bos taurus*) in its anatomical structure, having only twelve joints in its tail, while the ox has twenty-one. In that division also of the back bone which contains what anatomists call the dorsal vertebræ, there are fourteen joints in the Buffalo and thirteen in the ox. And lastly the Buffalo has only five sacral vertebræ, while the ox has six; thus although the whole number of joints in the back bone, excluding the tail, is the same, yet their anatomical characters and distribution are somewhat different. A difference in the number of caudal vertebræ would not constitute a generic distinction, unless there were other points of variance. Adubon and Bachman's account of the genus is as follows:—

"Head, large and broad; forehead, slighty arched; horns, placed before the salient line of the frontal crest; tail, short; shoulders, elevated; hair, soft and woolly."

"The generic name is derived from Pliny, who applied the word Bison, Wild Ox, to one of the species on the Eastern continent.

"There are five species of Buffalo that may be conveniently arranged under this genus: one existing in the forests of Southern Russia, in Asia, in the Circassian Mountains, and the Desert of Kobi, one in Ethiopia and the forests of India, one on the mountains of Central Asia, one in Ceylon, and one in America. In addition to this the genus Bos, which formerly included the present, contains five well determined species: one inhabiting the country near the Cape of Good Hope, one in Central Africa, one in the Himalaya Mountains and the Birman Empire, one in India, and one in the forests of middle Europe." (Adubon and Bachman, vol. 2, page 32.)

Bison Americanus.—Gmel.

Specific Characters.—*Forehead, broad; slightly arched horns, small, short, diverted laterally and upwards; tail, short; legs, slender; shoulders, elevated; hair, soft and woolly.*"

"This, the most gigantic of the indigenous mammalia of America, once overspread the entire southern half of the continent. At the time of the discovery by the Spaniards, an inhabitant even down to the shores of the Atlantic, it has been beaten back by the westward march of civilization, until, at the present day, it is only after passing the giant Missouri and the head-waters of the Mississippi that we find the American bison or buffalo. Many causes have combined to drive them away from their old haunts: the wholesale and indiscriminate slaughter by the whites, the extension of settlements, and the changes of the face of the country; but, above all, that mysterious dread of the white man, which pervades animal life in general as a congenital instinct."

"Still it would appear that the buffalo was originally confined within certain limits, which, perhaps, varied from time to time, as they certainly have done within comparatively a recent period. We have already referred to the fact of their existence on the

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Note.—The account of the Buffalo here given, is taken from a paper "on the ruminating animals of North America, and their susceptibility of domestication," by Professor S. F. Baird, of the Smithsonian Institution.—"Patent Office Report," Washington, 1851.

Atlantic coast; how far north they extended is not exactly known. Their existence in Pennsylvania, however, is substantiated by the occurrence of bones of this species in alluvial deposits of rivers, bogs, and caves. At the first settlement of Canada they were not known there. As to their southern range, Lawson speaks of their being found on Cape Fear River, in North Carolina. Theuet, in the very rare work entitled "Les Singularitez de la France antarctique," Paris, 1557, gives, (p. 147,) in a representation of a curious beast of West Florida, a readily recognisable figure of the buffalo. In the Hudson Bay country they did not pass east of the latitude of Red River; south they were found throughout the Mississippi valley, the South Atlantic States, Texas, and Mexico. Their western range was strictly limited to the Rocky Mountains, none extending beyond."

"At the present time none are found in the Atlantic States, nor even east of the Missouri, except in Minnesota, in the region of the upper Mississippi and the prairies of the Red River of the north. Their main range, however, is between the Missouri and the Rocky Mountains, from Texas and New Mexico to the Saskatchewan, and even as far north as Great Martin Lake, lat. 64°. Of late years they have found their way through the Rocky Mountains to the plains of the Columbia by the great middle pass, and north of this on the head-waters of the Saskatchewan."

"Imagination can scarcely realize the numbers of buffalo which, even now, are found on the western plains. It is not uncommon to see the prairies covered with them as far as the eye can reach; and travellers have passed through them for days and days in succession, with scarcely any apparent diminution in the mass. The paths worn in the plains resemble more the beaten highways of civilization than the mere aggregation of individual hoof-marks. As their routes are, in most cases, selected with the unerring instinct of animal existence, extending in a straight line from one convenient crossing-place of river or ravine to another, and taking the most available springs or streams in their course, they well justify the remark of Mr. Benton as to their agency in defining the high roads of travel across the prairies, for which they frequently serve almost without an alteration."

"Still, vast as these herds are, their numbers are much less than in earlier times, and they are diminishing with fearful rapidity. Every year sees more or less change in this respect, as well as alterations of their great line of travel. To the Indian, dependent for the very necessaries of life upon the buffalo, these facts come home with stern reality. His existence is bound up inseparably with that of the race of buffalo, and every consideration of humanity to the one prompts a care over the other."

"If it were possible to enforce game-laws, or any other laws on the prairies, it would be well to attach the most stringent penalties against the barbarous practice of killing buffalo merely for the sport, or perhaps for the sake of the tongue alone. Thousands are killed every year in this way. After all, however, it is, perhaps, the Indian himself who commits the mischief most wantonly. A frequent mode of hunting the buffalo by them consists in making a "surround." This is done by enclosing a large herd and driving them over a precipice upon the rocks, or into one of the profound ravines which intersect the prairies in various directions. In this way thousands are sometimes killed in a single day. Fires in prairies, too, do their share in the work of destruction, either by their immediate agency or by driving the maddened animals into the ravines just referred to."

Mr. Picotte, an experienced partner of the American Fur Company, estimated the number of buffalo robes sent to St. Louis in 1850 at 100,000. Supposing each of the 60,000 Indians on the Missouri to use ten robes for his wearing apparel every year, besides those for new lodges and other purposes, by the calculation of Mr. Picotte we shall have an aggregate of 400,000 robes. We may suppose 100,000 as the number killed wantonly, or destroyed by fire or other causualties, and we will have the grand total of half a million of buffalo destroyed every year. This, too, does not include the numbers slaughtered on Red River, and other gathering points.

It is, perhaps, unnecessary to state that the American bison is not found in the Old World. A European species of the same genus, *Bos*, and closely allied, is the *Bos urus*, aurochs of Germany, urus of Cæsar, bonossus of Aristotle, and bison of Pausanius and Pliny. This species, once of rather wide range, is now confined to the country between the Caspian and the Black Sea, where it is protected from injury by the severest legislative enactments. Other species are found in various other parts of the world.

The skins of the American buffalo are dressed as follows: "After being taken off the animal, they are hung on a post, and the adhering flesh taken off with a bone toothed something like a saw. This is performed by scraping the skin downward, requiring much labor. The hide is then stretched on the ground, and fastened down with pegs; it is then allowed to remain a day or two, or till dry. After this, the flesh side is pared down with the blade of a knife fastened in a bone, called a grate, which renders the skin even, and takes off about a quarter of its thickness. The hair is taken off with the same instrument; and these operations being performed, and the skin reduced to a proper thickness, it is covered over either with brains, liver, or grease, and left for a night. The next day the skin is rubbed and scraped, either in the sun or by a fire, until the greasy matter has been worked into it, and it is nearly dry; a cord is then fastened to two poles, and over this the skin is thrown, and pulled, rubbed, and worked till quite dry. After this it is sewed together around the edges, excepting at one end. A smoke is made with rotten wood in a hole dug in the earth, and the skin is suspended over it on sticks set up like a tripod, and thoroughly smoked; which completes the tanning, and renders it capable of bearing wet without losing its softness or pliability afterwards."

Buffalo robes are dressed in the same manner, excepting that the hair is not removed, and they are not smoked. They are generally divided into two parts; a strip is taken from each half on the back of the skin where the hump was, and the two halves, or sides, are sewed together, after they are dressed, with thread made of the sinews of the animal, and then the robe is ready for market.

One of the most useful applications of buffalo meat consists in the preparation of pemmican—an article of food of the greatest importance, from its portability and nutricious qualities. This is prepared by cutting the lean meat into thin slices, exposing it to the heat of the sun or fire, and, when dry, pounding it to a powder. It is then mixed with an equal weight of buffalo suet, and stuffed into bladders. Sometimes venison is used instead of buffalo beef. Sir John Richardson, while preparing for his recent Arctic expedition, found it necessary to carry with him pemmican from England. This he prepared by taking a round or buttock of beef, cut into thin steaks, from which the fat and membraneous parts were pared away, and dried in a kiln until the fibre of the meat became friable. It was then ground in a malt-mill, and mixed with nearly an equal weight of beef suet or lard. This completed the preparation of the plain pemmican; but to a portion raisins were added, and another portion was sweetened with sugar. These latter changes were subsequently highly approved by the voyageurs. The pemmican was then placed in tin canisters, and well rammed down; and after the cooling and contraction of the mass, these were filled with melted lard through a small hole left in the end, which was then covered with a piece of tin, and soldered up. The total amount of beef used by Sir John Richardson amounted to 35,651 pounds; of lard, to 7549 pounds; of currants, to 1008 pounds; of sugar, to 280 pounds. These material constituted 17,424 pounds of pemmican, costing at the rate of 1 shilling 7½ pence (36 cents) per pound.

The meat biscuit of Mr. Borden, now manufactured from beef by him at Galveston in large quantities, is also of much economical importance.

We conclude our article, already extended to unreasonable length, by presenting an account of some domesticated buffaloes, which, better than any language of our own, will present the question of domestication in a proper light. It is taken from Audubon and Bachman's Quadrupeds, as furnished these gentlemen by Robert Wickliffe, Esq., of Lexington, Ky., who has tried the experiment fully.

"The herd of buffalo I now possess have descended from one or two cows that I purchased from a man who brought them from the country called the Upper Missouri. I have had them for about thirty years; but from giving them away, and the occasional killing of them by mischievous persons, as well as other causes, my whole stock at this time does not exceed ten or twelve. I have sometimes confined them in separate parks from other cattle, but generally they herd and feed with my stock of farm-cattle. They graze in company with them as gently as the others. The buffalo cows, I think, go with young about the same time the common cow does, and produce once a year. None of mine have ever had more than one at a birth.

"Although the buffalo, like the domestic cow, brings forth its young at different seasons of the year, this I attribute to the effect of domestication, as it is different with all animals in a state of nature. I have always heard their time for calving in our latitude was from March until July; and it is very obviously the season which nature assigns for the increase of both races, as most of my calves were from the buffaloes and common cows at this season. On getting possession of the tame buffalo, I endeavored to cross them as much as I could with my common cows, to which experiment I found the tame or common bull unwilling to accede; and he was always shy of a buffalo cow, but the buffalo bull was willing to breed with the common cow.

"From the common cow I have several half breeds, one of which was a heifer. This I put with a domestic bull, and it produced a bull calf. This I castrated, and it made a very fine steer, and when killed produced very fine beef. I bred from this same heifer several calves, and then, that the experiment might be perfect, I put one of them to the buffalo bull, and she brought me a bull-calf, which I raised to be a very fine, large animal,—perhaps the only one to be met with in the world of this blood, viz: a three-quarter, half-quarter, and half-quarter of common blood. After making these experiments, I have left them to propagate their blood themselves, so that I have only had a few half-breeds, and they always prove the same, even by a buffalo bull. The full-blood is not as large as the improved stock, but as large as the ordinary stock of the country. The crossed or half-blood are larger than either the buffalo or common cow. The hump, brisket, ribs, and tongue of the full and half blooded are preferable to those of the common beef; but the round and other parts are much inferior. The udder or bag of the buffalo is smaller than that of the common cow; but I have allowed the calves of both to run with their dams upon the same pasture, and those of the buffalo were always the fattest; and old hunters have told me that when a young buffalo calf is taken it requires the milk of two common cows to raise it. Of this I have no doubt, having received the same information from hunters of the greatest veracity. The bag or udder of the half-breed is larger than that of the full-blooded animals, and they would, I have no doubt, make good milkers.

"The wool of the wild buffalo grows on their descendants when domesticated, but I think they have less wool than their progenitors. The domesticated buffalo still retains the grunt of the wild animal, and is incapable of making any other noise, and they still observe the habit of having select places within their feeding-grounds to wallow in.

"The buffalo has a much deeper shoulder than the tame ox, but is lighter behind. He walks more actively than the latter, and I think has more strength than a common ox of the same weight. I have broken them to the yoke, and found them capable of making excellent oxen; and for drawing wagons, carts, or other heavily-laden vehicles, on long journeys, they would, I think, be greatly preferable to the common ox. I have as yet had no opportunity of testing the longevity of the buffalo, as all mine that have died did so from accident, or were killed because they became aged. I have some cows that are nearly twenty years old, that are healthy and vigorous, and one of them has now a sucking-calf. The young buffalo calf is of a sandy-red or rufous color, and commences changing to a dark brown at about six months old, which last color it always retains. The mixed breeds are of various colors. I have had them striped with black on a gray ground, like the zebra; some of them brindled red; some pure red, with white faces; and others red, without any markings of white. The mixed bloods have not only produced in my stock from the tame and buffalo bull, but I have seen the half bloods reproducing, viz: those that were the product of the common cow and wild buffalo bull. I was informed that, at the first settlement of the country, cows that were considered the best for milking were from the half-blood down to the quarter, and even eighth, of the buffalo blood. But my experiments have not satisfied me that the half buffalo bull will produce again. That the half-breed heifer will be productive from either race, as I have before stated, I have tested beyond the possibility of doubt.

"The domesticated buffalo retains the same haughty bearing that distinguishes him in his natural state. He will, however, feed or fatten on whatever suits the tame cow, and requires about the same amount of food. I have never milked either the full blood or mixed breed, but have no doubt they might be made good milkers, although their bags or udders are less than those of the common cow; yet, from the strength of the calf, the dam must yield as much, or even more, milk than the common cow."

ARTICLE XLIX.—*On the Musk Ox,* (*Ovibos moschatus.*)

The Musk-Ox, the most remarkable member of the whole Ox Tribe, is strictly confined to the Arctic portion of the British Provinces lying far north of Canada. The geographical range of the species is so distant from any climate endurable by civilized man, that it appears to be beyond the reach of even the Hudson's Bay Company. That an animal possessing the same arrangement of teeth as the domestic ox, and in other respects but very slightly differing from the comparatively helpless creature that man has made his servant, should be capable of leading a happy life amid the perpetual ice and snow of the Arctic Circle, shews how a single delicate turn of the Creator's hand can adapt organic structures almost exactly similar, to very opposite conditions of existence. When we compare the musk ox with the common ox, and reflect upon the vast space that separates them, we can no longer wonder that the extinct elephant could have lived in Siberia, where its representatives of our day would have perished in a single season. The dental formula of the musk-ox is the same as that of the buffalo: incisive, $\frac{0}{8}$; canine, $\frac{0}{0}-\frac{0}{0}$; molar, $\frac{6}{6}-\frac{6}{6}=32$. The horns spring out of the top of the head, being in contact at their bases, bent down the sides of the neck, then curved upwards. The body is low, and compactly built.

General colour of the hair, brown, long, matted, and rather curled on the neck and between the shoulders, where it is rather grizzled; on the back and hips, long but lying smoothly; on the shoulders, sides, and thighs, it is so long as to hang down below the middle of the leg. There is on the centre of the back a mark of a soiled brownish-white, called by Captain Parry the saddle. On the throat and chest the hair is very straight and long, and together with the long hair on the lower jaw, hangs down like a beard and dewlap. The short tail is concealed by the fur of the hips. There is a large quantity of fine brownish ash-coloured wool or down among the hair covering the body. The hair on the legs is short, dull brownish-white, unmixed with wool. The hoofs are longer than those of the caribou, but so similar in form that it requires the eye of a practised hunter to distinguish the impressions. In the cow, which is smaller than the bull, the horns are smaller, and their bases, instead of touching, are separated by a hairy space. The hair on the throat and chest is also shorter.

This is the Bœuf Musqué of Jeremie; Musk Ox of Drage, Dobbs, Ellis, Pennant, Hearne, and Parry; *Bos moschatus* of Gmelin, Sabine, and Richardson, (Parry's "Second Voyage;") Matech Moostoos (Ugly Bison) of the Cree Indians; Adgiddah-yawseh (Little Bison) of the Chepewyans and Copper Indians; and Oomingmak of the Esquimaux.

The barren lands of America lying to the northward of the 60th parallel are the principal habitations of the musk ox. Tracks were once seen by Hearne within a few miles of Fort Churchill, in lat. 59°; and he saw many in his first northern journey, in about lat. 61°. Richardson was informed that they do not now come so far to the southward, even on the Hudson's Bay shore; and he adds that farther to the westward they are rarely seen in any numbers lower than lat. 67°, although, from portions of their skulls and horns which are occasionally found near the northern borders of the Great Slave Lake, he thinks it probable that they ranged at no very distant period over the whole country lying between that great sheet of water and the Polar Sea. He had not heard of their having been seen on the banks of Mackenzie's River to the southward of Great Bear Lake, and he states that they do not come to the south-western end of that lake, although they existed in numbers on its north-eastern arm. "They range," continues he, "over the islands which lie to the north of the American continent, so far as Melville Island, in lat. 75°, but they do not, like the rein-deer, extend to Greenland, Spitzbergen, or Lapland. From Indian information we learn that to the westward of the Rocky Mountains, which skirt the MacKenzie, there is an extensive tract of barren country, which is also inhabited by the musk ox and reindeer. It is to the Russian traders that we must look for information on this head; but it is probable that, owing to the greater mildness of the climate to the westward of the Rocky Mountains the musk ox, which affects a cold barren district, where grass is replaced by lichens, does not range so far to the southward on the Pacific coast as it does on the shores of Hudson's Bay. It is not known in New Caledonia, nor on the banks of the Columbia, nor is it found on the Rocky Mountain ridge at the usual crossing places near the sources of the Peace, Elk, and Saskatchewan Rivers. It is therefore fair to conclude that the animal described by Fathers Marco de Niça and Gomara as an inhabitant of New Mexico, and which Pennant refers to the musk ox, is of a different species. The musk ox has not crossed over to the Asiatic shore, and does not exist in Siberia, although fossil skulls have been found there of a species nearly allied, which has been enumerated in systematic works under the name of *Ovibos Pallantis*. The appearance of musk oxen on Melville Island in the month of May, as ascertained on Captain Parry's first voyage, is interesting, not merely as a part of their natural history, but as giving us reason to infer that a chain of islands lies between Melville Island and Cape Lyon, or that Wollaston and Banks' Lands form one great island, over which the migrations of the animals must have been performed. The districts inhabited by the musk ox are the proper lands of the Esquimaux;

and neither the northern Indians nor the Crees have an original name for it, both terming it Bison with an additional epithet."

Sir John Richardson, who had the best opportunities of coming at the truth, informs us that the country frequented by the musk ox is mostly rocky, and destitute of wood, except on the banks of the larger rivers, which are more or less thickly clothed with spruce trees. Their food, he tells us, is similar to that of the caribou, grass at one season and lichens at another; and the contents of its paunch are eaten by the natives with the same relish as that with which they devour the "nerrooks" of the caribou. The dung is voided in round pellets, which are larger than those which come from the caribou. The animal runs fast, short as are its legs, and hills and rocks are easily climbed by this ox of the northern deserts. One pursued by Richardson's party on the banks of the Coppermine River scaled a lofty sand-cliff with so great a declivity that they were obliged to crawl on hand and knees to follow the chase. The musk oxen assemble in herds of from twenty to thirty, are in their rut about the end of August and beginning of September, and bring forth one calf about the latter end of May or beginning of June. Hearne accounts for the few bulls which are seen by supposing that they kill each other in their contest for the cows.

Richardson thus graphically describes the terror of a huddled herd:—"If the hunters keep themselves concealed when they fire upon a herd of musk oxen, the poor animals mistake the noise for thunder, and, forming themselves into a group, crowd nearer and nearer together, as their companions fall around them; but should they discover their enemies by sight, or by their sense of smell, which is very acute, the whole herd seek for safety by instant flight. The bulls, however, are very irascible, and, particularly when wounded, will often attack the hunter, and endanger his life, unless he possesses both activity and presence of mind. The Esquimaux, who are well accustomed to the pursuit of this animal, sometimes turn its irritable disposition to good account; for an expert hunter having provoked a bull to attack him, wheels round it more quickly than it can turn, and by repeated stabs in the belly puts an end to its life."

Mr. Jeremie, who first brought the animal into notice, carried some of its wool to France, where some stockings were made of it, said to have been equal to the finest silk. Sir John Richardson says that this wool resembles that of the Bison, but is perhaps finer, and would in his opinion be highly useful in the arts, if it could be procured in sufficient quantity. The same author informs us that when the animal is fat its flesh is well tasted, and resembles that of the caribou, but has a coarser grain. The flesh of the bulls is high flavoured, and both bulls and cows when lean smell strongly of musk, their flesh at the same time being very dark and tough, and certainly far inferior to that of any other ruminating animal in North America. The carcass of a musk ox weighs, exclusive of the offal, about three hundred-weight, or nearly three times as much as a barren-ground caribou, and twice as much as one of the woodland caribou. (Richardson, "Fauna Borealia-Americana," English Cyclopedea, &c.)

ARTICLE L.—*The Rocky Mountain Sheep*, (*Ovis montana.*)

GENUS OVIS.—Linn.

Dental Formula.

Incisive $\frac{6}{8}$; *Canine* $\frac{0}{0}$—$\frac{0}{0}$; *Molar* $\frac{6}{6}$—$\frac{6}{6}$ = 32.

"Horns, common to both sexes; sometimes wanting in the females; they are voluminous, more or less angular-transversely wrinkled, turned laterally in spiral directions, and enveloping an osseous arch, cellular in structure.

"They have no lachrymal sinus, no true beard to the chin; the females have two mammæ; tail, rather short; ears, small, erect; legs, rather slender; hair, of two kinds, one hard and close, the other woolly; gregarious. Habit, analagous to the goats. Inhabit the highest mountains of the four quarters of the globe.

"The generic name is derived from the Latin *ovis*, a sheep.

"There are four well determined species: one, the mouflon of Buffon, musmon (*ovis musmon*,) is received as the parent of the domesticated races; it is found in Corsica, Sardinia, and the highest mountain chains of Europe; one inhabiting the mountains and steppes of northern Asia, Tartary, Siberia and the Kurile Islands; one the mountains of Egypt, and one America."

Ovis Montana—Desm.

Rocky Mountain Sheep or Big Horn.

"Specific Characters.—*Longer than the domestic sheep; horns of the male, long, strong and triangular; those of the female, com-*

pressed; colour, deep rufous gray, a large white disk on the rump." (Audubon and Bachman, vol. 2, page 163.)

The Rocky Mountain sheep is the only animal of the genus indigenous to North America, and is confined in its distribution strictly to the range of mountains from which it takes its name. It occurs as far north as latitude 60° and frequents the highest peaks of the mountains southward to California. In the far West there is an extraordinary tract of country called by the French Canadian hunters "mauvaises terres," covered over with thousands of conical hills, so narrow at the base and so high that they resemble a collection of vast irregular sugar loaves. These hills are composed of horizontal strata of hardened clay, coal and earth mixed with petrified shells, bones and plants. The same strata, recognized by their colour or composition, are seen in all the hills at the same elevation, thus proving that the valleys have been excavated by running water or some other cause, leaving the hundreds of tall pillar-like eminences as so many islands in the cavity of a sea that has become empty of its waters.

The Rocky Mountain sheep loves to climb the highest pinnacles of the "mauvaises terres," where neither the prowling wolf nor the wandering hunter can reach or ascend. It is said that they are so sure-footed that they run at full speed along narrow ledges in the face of perpendicular precipices, five hundred or more feet above the plain. They form paths around the lofty clay cliffs that are sometimes six to eight hundred feet or even fifteen hundred feet high, and mounting to the summit bid defiance to all enemies. One would scarcely suppose that the clumsy foot of a cow was the best adapted for climbing almost perpendicular walls, and yet we find that among the best climbers are the goats and the sheep, with feet constructed upon exactly the same plan. The adaptations of nature consist not only in the contrivance of organic structures, but in the faculty of applying these to most varied purposes, in order to attain certain desired ends.

The Rocky Mountain sheep is described as resembling a deer with the head of a large ram. "The horns are of immense size, being nearly three feet in length, and with their bases so large that they occupy the whole of the upper part of the head. They form a regular curve, first backwards, then downwards and outwards, the extremities being eighteen inches apart. They are flattened on the sides and deeply corrugated, the horns rising immediately behind.

"The ears and tail are short; the hair bears no resemblance to wool, but is similar to that of the American elk or reindeer. It is slighty crimped throughout its whole length, two inches in length on the back, and one inch and a-half on the sides. The general colour of the animal is greyish brown, but with the rump and belly greyish white. The tail and hoofs are black.

"The female resembles some of the finest specimens of the common ram. The neck is a little longer, as are also the head and legs, and in consequence it stands much higher. Its horns resemble more those of the goat than the sheep; in fact, whilst the fine erect body of the male reminds one of a large deer with the head of a ram, while the female looks like a fine specimen of antelope.

"They are shy, wary and most difficult of approach, and when wounded run up the precipice, where they die in places inaccessible to the hunter. They are gregarious, being often seen in flocks of from twenty to thirty. In the winter and spring the females and the young males band together. The ewes bring forth in June and July one or two at a birth. The old rams fight terrific battles with each other. It is said that they sometimes spring from the rocks and alight on their head upon the earth below without injury, the elasticity of their horns breaking a portion of the violence of the shock, while the strength of the neck, which in the sheep tribe is formed to resist violent concussions, is sufficient to withstand the remainder.

"Where they have often been fired at, they alarm their companions by a loud hissing noise, when the whole flock take to flight, and when once they get a view of the hunter they remain on the watch during the whole of that day. The flesh is compared to that of the most delicious venison. Like the deer they are fond of mineral waters, and are in the habit of paying daily visits to springs or caves in the mountains where saline efflorescences abound. Their food consists of grasses, tender vines and leaves.

"Although found in the British possessions, this animal does not descend into the plain country of the Hudson's Bay Territory, and it is not therefore made an article of commerce by the traders, for which in fact no part of the animal, except the skin and the head as a curiosity, could be of value."

"This animal has been known to Europeans since 1697, when Father Picolo, a Catholic missionary to California, represented it "as large as a calf of one or two years old; its head, much like that of a stag, and its horns, which are very large, like those of a ram; its tail and hair, speckled, and shorter than a stag's, but its hoof is large round, and cleft as an ox's. I have eaten of these beasts, he says, and their flesh is very tender and delicious."

Dr. Gray, in his British Museum Catalogue, divides the Sheep Tribe into four genera, *Ovis*, *Caprovis*, *Pseudovis* and *Ammotragus*. To the first belongs the domestic sheep, *Ovis aries*, which contains thirty-three varieties. To the second belongs the Rocky Mountain sheep, and he calls it *Caprovis Canadensis*. There is a variety of species in California which some authors, but it appears without sufficient grounds, consider a distinct species, and they call it *Ovis Californica*. There is, however, in the opinion of AUDUBON and BACHMAN, who are certainly the best authorities on the viviparous quadrupeds of North America, no reason for the separation.

ARTICLE LI.—*On the Skunk, (Mephitis chinga.)*

GENUS MEPHITIS.—CUV.

DENTAL FORMULA.

Incisive, $\frac{6}{6}$; *Canine*, $\frac{1}{1}$—$\frac{1}{1}$; *Molar*, $\frac{4}{5}$—$\frac{4}{5}$ = 34.

GENERIC CHARACTERS.—Canine teeth, very strong, conical; two small anterior cheek teeth or false molars above, and three below, on each side; the superior tuberculous teeth, very large, as broad as they are long; inferior molars, having two tubercles on the inner side; head, short; nose, somewhat projecting; snout, in most of the species blunt.

Feet, with five toes; toes on the fore-feet, armed with long curved nails, indicating the habit of burrowing in the earth; heel, very little raised in walking.

Hairs on the body usually long, and on the tail very long.

The anal glands secrete a liquor which is excessively fetid. The various species of this genus burrow in the ground, or dwell in fissures of rocks, living on poultry, birds' eggs, small quadrupeds and insects. They move slowly, and seldom attempt to run from man, unless they chance to be near their burrows. They are, to a considerable extent, gregarious, large families being occasionally found in the same hole.

In the recent work of Dr. Lichenstein, (Ueber die Gattung Mephitis, Berlin, 1838,) seventeen species of this genus are enumerated, one of which is found at the Cape of Good Hope, two in the United States of America, and the remainder in Mexico and South America.

The generic name, *Mephitis*, is derived from the Latin word *mephitis*, a strong odour.

MEPHITIS CHINGA.

SPECIFIC CHARACTERS.—*Size of a cat; general colour, blackish-brown, with white longitudinal stripes on the back; many varieties in its white markings; tail long and bushy.*—(Audubon and Bachman, vol. 1, page 317.)

This little animal has a broad, fleshy body, wider at the hips than at the shoulders, long coarse fur, and short legs. The head is small; nose, obtuse, covered with hair to the snout, which is naked; ears, short, broad and rounded; feet, broad, covered with hair, concealing the nails; palms, naked; trunk of tail, nearly half as long as the body. The hair on the tail is very long and bushy; the general colour blackish-brown; a white stripe commences on the nose, and runs to the top of the head; another patch of white on the back of the neck, and two stripes of the same on each side of the back. Sometimes the tail is tipped with white, but the amount of this colour varies a good deal on the different individuals.

The skunk is carnivorous, its prey being small birds, eggs, insects, mice, frogs and lizards. It is particularly destructive in the poultry yard. Like the fox, it burrows in the ground, but generally in a flat surface, rather than in the side of a hill, as is the habit with the former. These holes extend from six to eight feet horizontally, about two feet beneath the surface, and terminate in a chamber of considerable dimensions, where there is a large and comfortable bed of dry leaves. In this apartment, during winter, a number of skunks, sometimes, it is said, from five to fifteen, may be found snugly coiled up. Some of the dens have several entrances to the principal chamber. They retire to their holes in the latter end of autumn, and do not come out again until spring, like the bear, supporting existence upon the fat accumulated during the summer season. In the Southern States they are at large during the whole year, the climate being sufficiently warm during the winter months to suit their organization.

Although, in self-defence, capable of emitting an odour perhaps the most offensive in nature, yet the skunk is an exceedingly cleanly animal, and although a dozen may be concealed in a single burrow, yet not the slightest unpleasant smell can be detected at the entrance. The flesh is eaten by the Indians, and pronounced by them superior to that of the raccoon or opossum.

"The offensive fluid is contained in two small sacks, situated on each side of the roots of the tail, and is ejected through small ducts near the anus. When the skunk is irritated, or finds it necessary to defend himself, he elevates his tail over his back, and, by a strong muscular exertion, ejects it in two thread-like streams in the direction in which the enemy is observed. He appears to take an almost unerring aim, and almost invariably salutes a dog in his face and eyes. He can throw the fluid five yards or more. The notion of the old authors, that this fluid is the urine thrown to a distance by the aid of his long tail, is erroneous. The skunk never permits a drop to touch his fur, and while defending himself his tail is carefully thrown up over his back. It is only after being worried by dogs that the smell is perceived on the body of the animal, as well as upon his destroyers. If suddenly killed by a shot through a vital part, the skunk has no smell, and may be skinned with less inconvenience to the olfactory organ than would be experienced from skinning a mink or marten."

The young are produced in the early part of the spring, and from five to nine in a litter.

This species of skunk is found all over the British possessions, as high as 57° north, and ranges south to Kentucky, Carolina, and Alabama. It is rather common in Upper and Lower Canada.

In the month of April last we found a skunk in the Rideau Canal, which had apparently been drowned in attempting to swim across; and, a few days after, another was shot by Mr. Lett, of Ottawa. We have the skulls of both.

Audubon, from whose writings we have gleaned the greater portion of the above, says, that to capture a skunk was one of his first attempts at a collection of natural history, and he thus eloquently describes the result:—

"There is no quadruped on the continent of North America the approach of which is more generally detested than that of the skunk; from which we may learn, that although from the great and the strong we have to apprehend danger, the feeble and apparently insignificant may have it in their power to annoy almost beyond endurance. In the human species we sometimes perceive that a particular faculty has received an extraordinary development, the result of constant devotion to one subject, whilst in other respects the mind of the individual is of a very ordinary character. The same remark will hold good applied to any particular organ of the body, which, by constant use (like the organs of touch in the blind man,) becomes so improved as to serve as a substitute in others; but in the lower orders of animals this prominence in a particular organ is the result of its peculiar conformation, or of instinct. Thus, the power of the rhinoceros is exerted chiefly by his nasal horn; the wild boar relies for defence upon his tusks; the safety of the kangaroo depends on his hind feet, which not only enable him to make extraordinary leaps, but with which he deals vigorous blows; the bull attacks his foes with his horns; the rattlesnake's deadly venom is conveyed through its fangs; and the bee has the means of destroying some of its enemies by its sting; whilst in every other power, for attack or self-defence, these various creatures are comparatively feeble.

"The skunk, although armed with claws and teeth strong and sharp enough to capture his prey, is slow on foot, apparently timid, and would be unable to escape from many of his enemies, if he were not possessed of a power by which he often causes the most ferocious to make a rapid retreat, run their noses into the earth, and roll or tumble on the ground as if in convulsions; and not unfrequently, even the bravest of our boasting race is by this little animal compelled to break off his train of thought, *hold his nose*, and run, as if a lion were at his heels!

"Among the first specimens of natural history we attempted to procure was the skunk; and the sage advice to "look before you leap" was impressed on our mind, through several of our senses, by this species.

"It happened in our early school-boy days, that once, when the sun had just set, as we were slowly wending our way home from the house of a neighbour, we observed in the path before us a pretty little animal, playful as a kitten, moving quietly along; soon it stopped, as if waiting for us to come near, throwing up its long bushy tail, turning round and looking at us like some old acquaintance; we pause and gaze: what is it? It is not a young puppy or a cat; it is more gentle than either; it seems desirous to keep company with us, and, like a pet poodle, appears most happy when only a few paces in advance, preceding us, as if to shew the path; what a pretty creature to carry home in our arms! It seems too gentle to bite; let us catch it. We run towards it; it makes no effort to escape, but waits for us; it raises its tail, as if to invite us to take hold of its brush; we seize it instanter, and grasp it with the energy of a miser clutching a box of diamonds; a short struggle ensues,—when faugh! we are suffocated; our eyes, nose and face are suddenly bespattered with the most horrible fetid fluid. Imagine to yourself, reader, our surprise, our disgust, the sickening feelings that almost overcome us. We drop our prize and take to our heels, too stubborn to cry, but too much alarmed and discomfited, just now, to take another look at the cause of our misfortune, and effectually undeceived as to the real character of this seemingly mild and playful little fellow."

The principal synonym of this species is *Mephitis Americana.* The name *Chinga* was given by Tiedimann, in 1808. As we have not access to that work, we cannot give the etymology of the word, unless it is derived from the Greek verb *chenga*, to pour out or diffuse.

ARTICLE LII.—*On the Canada Porcupine,* (*Hystrix dorsata.*)

GENUS HYSTRIX.—Linn.

Dental Formula.

Incisive, $\frac{2}{2}$; *Canine*, $\frac{0}{0}$—$\frac{0}{0}$; *Molar*, $\frac{4}{4}$—$\frac{4}{4}$ = 20.

Superior incisors on the anterior portion, smooth, cruciform at their extremity; inferior incisors, strong and compressed; molars, compound, with flat crowns, variously modified by plates of enamel, between which are depressed intervals. Head, strong; snout, thick and turned; ears, short and round; tongue, bristled with scaly spines; fore-feet, four-toed; hind feet, five-toed; all the toes armed with powerful nails.

Spines on the body, sometimes intermixed with hairs; tail, moderately long, in some species of the genus prehensile. Herbivorous, feeding principally on grain, fruits, roots and the bark of trees; dig holes in the earth, or nestle in the hollows of trees.

The generic name is derived from the Greek word *hustrix*, a porcupine; *hus*, a hog, and *trix*, a bristle. There are two species in North, and three in South America, one in Southern Europe, one in Africa, and one in India.

HYSTRIX DORSATA.—Linn.

CANADA PORCUPINE.

SPECIFIC CHARACTERS.—*Spines, short, partially concealed by long hairs; no mane; long bristles on the head and neck; colour varying between light brown and black.*

The porcupine, of all North American quadrupeds, possesses the strangest peculiarities in its organization and habits. In its movements it is the most sluggish of all our species. Although the skunk is slow of foot, he would prove in contemptible competition with it in a trial of speed. Under such circumstances the inquiry arises, what protection has this animal against the attacks of the wolverene, the lynx, the wolf and the cougar, and how long will it be before it becomes totally exterminated? But a wise Creator has endowed it with powers by which it can bid defiance to the whole ferine race, the grisly bear not excepted. If the skunk presents to its enemies a formidable battery, that stifles and burns at the same time, the porcupine is clothed in an impervious coat of mail glistening with bayonets.

This wonderful animal is found throughout North America from Labrador to the Rocky Mountains, and as far north as latitude 67°, on the Mackenzie River. Southerly, it ranges to the latitude of the northern parts of Pennsylvania, and is occasionally met with in Ohio. We are informed that in Gaspé, at the mouth of the St. Lawrence, it is very abundant. It exists, but not plentifully, in all parts of Upper and Lower Canada.

Its food is exclusively vegetable, and, like the beaver, in the winter season, it feeds upon the bark of trees. For this purpose nature has provided feet armed with long, strong and sharp claws, by the aid of which the porcupine readily ascends trees of all dimensions. The bark of the small ones, however, appears to furnish the favorite food, and these are completely stripped and destroyed. It is said that a single porcupine will destroy all the young trees on several acres of ground in one winter season. A writer (Cartwright) says: "When he mounts into a tree he does not come down until he has eaten the bark from the top to the bottom. He generally makes his course through the wood in a straight direction, seldom missing a tree, unless such as are old. He loves young ones best, and devours so much (only eating the inner part of the rind) that I have frequently known one porcupine to ruin nearly a hundred trees in a winter. A man who is acquainted with these animals will seldom miss finding them when the snow is on the ground. If he can hit upon the rinding of that winter, by making a circuit around the barked trees, he will soon come on his track, unless a very deep snow should have chanced to fall after his last ascent. Having discovered that, he will not be long ere he find the animal."

In reference to the manner in which the porcupine defends itself with its quills, the same writer says:—"It is a received opinion that a porcupine can dart his quills at pleasure into a distant object; but I venture to affirm that this species cannot, (whatever any other may do,) for I have taken much pains to discover this fact. On the approach of danger he retreats to a hole, if possible; but where he cannot find one he seizes upon the best shelter that offers, sinks his nose between the forelegs, and defends himself by a sharp stroke of his tail or a sudden jerk of his back. As the quills are bearded at their points, and not deeply rooted in the skin, they stick firmly into whatever they penetrate; great care should be taken to extract them immediately, otherwise, by the muscular motion of the animal into which they are stuck, enforced by the beards of the quills, they soon work themselves quite through the part; but I never perceived the puncture attended with any worse symptoms than that of a chirurgical instrument."

A pet porcupine kept by Audubon "was occasionally let out of its cage to enjoy the benefit of a promenade in the garden. It had become very gentle, and evinced no spiteful propensities; and when its master called it, holding out at the time a sweet potatoe or apple, it would turn its head slowly towards him with a mild and wistful look, and then with a stately step advance and take the fruit from his hand. It then assumed an upright position, and conveyed the potatoe or apple to its mouth with its paws. When plagued it never evinced any spirit of resentment; but if a dog made his appearance, then in a moment it was armed at all points in defence. It would bend its nose downwards, erect its bristles, and, by a threatening sideway movement of the tail, give evidence that it was ready for the attack."

"A large, ferocious and exceedingly troublesome mastiff, belonging to the neighbourhood, had been in the habit of digging a hole under the fence and entering the garden. Early one morning he was observed making a dash at some object in the corner of the fence, which proved to be the porcupine, which had made its escape from the cage during the night. The dog seemed regardless of its threats, and, probably supposing it to be an animal not more formidable than a cat, sprung upon it with open mouth. The porcupine seemed to swell up in an instant, to double its size, and as the dog pounced upon it, it dealt him such a sidewise lateral blow with its tail as caused the mastiff to relinquish his hold instantly, and set up a loud howl in an agony of pain. His mouth, tongue and nose were full of porcupine quills. He could not close his jaws, but hurried open-mouthed out of the premises. It proved to him a lesson for life; as nothing could ever afterwards induce him to revisit a place where he had met with such an unneighbourly reception. Although the servants immediately extracted the spines from the mouth of the dog, his head was much swelled for several weeks afterwards, and it was two months before he finally recovered.

"The porcupine ate almost any kind of vegetable food presented to it,—cabbages, turnips, potatoes, apples, and even bread, and it usually cut to pieces everything placed in the cage that it could not consume. There was a large sweet bay tree in the garden, and the instant the door of the cage was opened, the porcupine would make its way to this tree, and not only feed greedily upon its bark, but on its leaves also. When once it was fixed upon the tree it was exceedingly difficult to induce it to come down, and on such occasions only would it turn and growl at its master. At night it was occasionally heard to utter a shrill note, that might be called a low querulous shriek. This animal was kept in confinement at Charleston, in the Southern States, in a climate much warmer than that of its natural habitat, and as the hot season came on, the poor thing would lie for hours panting in the cage, lost its appetite, and died during the summer."

The nest of the porcupine is constructed in a hollow tree, or in small caves under rocks. The young are produced in April or May, generally two at a litter. Sometimes three, and even four, have been found in a nest. The flesh is eaten, and tastes somewhat like flabby pork. The Indians make considerable use of the quills, in ornamenting moccasins, shot-pouches, or birch-bark baskets, for which purpose they are dyed of various colours.

The following account of this singular creature is principally from Audubon and Bachman :—

"The body of this species is thick, very broad, cylindrical, and, to a high degree, clumsy. The back is much arched in a curve from the nose to the buttocks, when it declines in an angle to the tail.

"The whole upper surface of the body, from the nose to the extremity of the tail, is covered by long and rather coarse hair, intermixed with a dense mass of spines or quills. These are of a cylindrical shape, very sharp at the extremity, and pointed at the roots. The animal is capable of erecting them at pleasure, and they are detached at the slightest touch. They are barbed with numerous small reversed points or prickles, which, when once inserted in the flesh, will, by the mere movement of the limbs, work themselves deeper into the body. There seems to be in certain parts of the body of this species a regular gradation from hair to spines. These spines continue to lengthen on the hinder parts of the head, to increase in size on the shoulders, and are longer and more rigid on the buttocks and thighs. In specimens of old animals the whole upper surface of the body is covered by a mass of quills, with their tufts of long hairs, six inches in length, on the forehead, shoulders, and along the sides.

"Head, rather small for the size of the animal, and very short; nose, truncated, broad, flattish above, and terminating abruptly; the eyes are lateral and small; ears, small, rounded, covered by short fur, and concealed by the adjoining long hair; incisors, large and strong.

"Legs, very short, and rather stout; claws, tolerably long, compressed, moderately arched and channelled beneath.

"There are tufts of hair situated between the toes; palms, naked and nearly oval, hard and tuberculous; on the fore feet there are four short toes, the second, counting from the inside, longest, the third a little smaller, the first a size less, and the fourth smallest; on the hind foot there are five toes, with claws corresponding to those on the fore foot. The hairs are so thickly and broadly arranged along the sides of the soles that they give a great apparent breadth to the foot, enabling this clumsy animal to walk with greater ease on the snow. It is plantigrade, and, like the bear, presses on the earth throughout the whole length of the soles. Tail, short and thick, covered above with spines, beneath with long rigid hairs; when walking or climbing it is turned a little upwards.

"The colour of the incisors, or cutting teeth, is deep orange; whole upper surface blackish-brown, interspersed with long hairs, many of them being eight inches in length; these hairs are four-fifths of their length dark-brown, with the points from one to two inches wide. There are also long white hairs interspersed under the fore legs, on the chest, and along the sides of the tail. The spines, or quills, which vary in length from one to four inches, are white from the roots to near their points, which are generally dark-brown or black, frequently brown and occasionally white. On some specimens the spines are so abundant, and protrude so far beyond the hair, that portions of the body, especially the hips, present a speckled appearance, owing to the preponderance of the long white quills tipped with black. The nails and the whole under surface are dark-brown."

There is a considerable difference both in the size and colour of different specimens. The length of the head and body is about 30 inches, of the tail (vertebræ) 7, to the end of the hair; $8\frac{1}{2}$, breadth of nose, $1\frac{1}{2}$; from heel to longest nail, $3\frac{1}{2}$. Audubon mentions a specimen in his possession, from Missouri, which was 13 inches broad on the back. Some of them are quite black, others greyish; when the quills are very long, they appear to be speckled with white when seen at a short distance.

ARTICLE LIII.—*On the Northern Hare, (Lepus Americanus.)*

GENUS LEPUS.—Linn.

Dental Formula.

Incisive, $\frac{4}{2}$; *Canine*, $\frac{0}{0}$—$\frac{0}{0}$; *Molar*, $\frac{6}{5}$—$\frac{6}{5}$ = 28.

Upper incisors, in pairs, two in the front, large and grooved, and two immediately behind, small; lower incisors, square; molars, with flat crowns and transverse laminæ of enamel; interior of the mouth, and soles of the feet, furnished with hair; ears and eyes, large; fore feet, with five toes; hind feet, with only four; hind legs, very long; tail, short; mammæ, from six to ten. The word *lepus* is derived from the Latin *lepus*, and Greek Æolic *leporis* a hare.

There are about thirty known species of this genus, of which rather the largest number (perhaps sixteen or seventeen species) exist in North and South America, while the remainder belong to the Eastern Continent.

Two species occur in British North America, of which that common in Canada, and somewhat famous from the amount of discussion it has received from Naturalists, is *Lepus borealis.* It occurs plentifully in all parts of the country, and especially in the neighbourhood of Montreal. Those exposed for sale in the market of that city are, just now, 1st December, changing from the summer to the winter colour, some of them being white and others brown.

Lepus Americanus.—Erxleben.

Specific Characters.—*Length, about 20 inches from the point of the nose to the root of the tail; colour, in summer, reddish-brown above, white beneath; in winter, white; roots of the hairs, blue, nearer the surface, fawn colour, and the tips white; ears, a little shorter than the head.*

The following is a portion of the long and excellent article, in Audubon and Bachman, on the natural history of this animal. The remainder, consisting of a discussion upon the identity of the species, we shall give in some future number:—

SYNONYMES.

Lievre, (Quenton Malisia,) Sagard Theodat, Canada, p. 747, 1636.
Swedish Hare, Kalm's Travels in North America. vol. ii., p. 45, 1749.
American Hare, Philos. Trans., London, vol. lxii., pp. 11, 376, 1772.
Lepus Americanus, Erxleben, Syst. Regni Animalis, p. 330, 1777.
" Nanus, Schreber, vol. ii., p. 881, pl. 234, fig.
" Hudsonius, Pallas, Glires, pp. 1, 30.
Varying Hare, Pennant, Arct. Zool., vol. i., p. 95.
Lepus Virginianus, Harlan, Fauna, p. 196, 1825.
" Variabilis, var. Godman, Nat. Hist., vol. ii., p. 164.
American Varying Hare, Doughty, Cabinet Nat. Hist., vol. i., p. 217, pl. 19. Autumn pelage.
The Northern Hare, Audubon, Ornithological Biog., vol. ii., p. 469. Birds of America, pl. 181, (in the talons of the Golden Eagle.) Winter pelage.
Lepus Americanus. Richardson, Fauna Boreali A., p. 217.
" Virginianus, Bach., Acad. Nat Sciences, Philadelphia, vol vii., p. 301.
" Americanus, Bach, ib., p. 403, and ib., vol. viii., p. 76.
" Americanus, Dekay, Nat. Hist. State of New York, p. 95, pl. 26.

DESCRIPTION.

Incisors, pure white, shorter and smaller than in *L. glacialis*; upper ones moderately grooved; the two posterior upper incisors very small. The margins of the orbits project considerably, having a distinct depression in the frontal bone; this is more conspicuous in the old than in the younger animals. Head rather short; nose blunt; eyes large and prominent; ears placed far back, and near each other; whiskers, long and numerous; body, enlongated, thickly clothed with long loose hair, with a soft downy fur beneath; legs, long; hind-legs, nearly twice the length of the forelegs; feet, thickly clothed with hair, completely concealing the nails, which are long, thin, very sharp, and slightly arched. So thickly are the soles covered with hair that an impression by the nails is not generally visible in their tracks made while passing over the snow, unless when running very fast. Tail, very short, covered with fur, but not very bushy; the form of this species is, on the whole, not very elegant; its long hind legs, although remarkably well adapted for rapid locomotion, and its diminutive tail, would lead the spectator at first sight to pronounce it an awkward animal, which is, nevertheless, far from being the fact. Its fur never lies smooth and compact, either in winter or summer, as does that of many other species, but seems to hang loosely on its back and sides, giving it a somewhat shaggy appearance. The hair on the body is in summer about an inch and a-half long, and in winter, a little longer.

COLOUR.

In summer, the whole of the upper surface is reddish-brown, formed by hairs that are at their roots and for two-thirds of their length, of a blueish ash colour, then reddish-yellow, succeeded by a narrow line of darkbrown, the part next the tips or points, reddish brown, but nearly all the hairs tipped with black—this colour predominating toward the rump. Whiskers, mostly black, a few white, the longest reaching beyond the head; ears, brown, with a narrow black border on the outer margin, and a slight fringe of white hairs on the inner. In some specimens there is a fawn and in others a light coloured edge around the eyes, and a few white hairs on the forehead. The pupil of the eye is dark, the iris, light silvery-yellow; point of nose, chin, and under the throat, white; neck, yellowish-brown. Inner surface of legs, and under surface of body, white; between the hind-legs, to the insertion of the tail, white; upper surface of the tail, brown, under surface, white. The summer dress of this species is assumed in April, and remains without much change till about the beginning of November in the latitude of Quebec, and till the middle of the same month, in the State of New York and the western parts of Pennsylvania; after which season the animal gains its winter pelage. During winter, in high northern latitudes, it becomes nearly pure white, with the exception of the black edge on the outer borders of the ears. In the latitude of Albany, New York, it has always a tinge of reddish-brown, more conspicuous in some specimens than in others, giving it a wavy appearance, especially when the animal is running, or when the fur is in the least agitated. In the winter season the hair is plumbeous at base, then reddish, and is broadly tipped with white. The parts of the body which are the last to assume the white change are the forehead and shoulders; we have two winter-killed specimens before us that have the forehead and a patch on the shoulders brown. On the under surface the fur in most specimens is white, even to the roots. A few long black hairs arise above and beneath the eyes, and extend backwards. The soles have a yellowish soiled appearance.

We possess a specimen of the young, about half grown, which in its general aspect resembles the adult; the colour of the back, however, is a shade darker, and the under surface an ashy white. The black edge is very conspicuous on the outer rim of the ear, and some of the whiskers are of unusual length, reaching beyond the head to the middle of the ear. The tail is very short, black above, and grayish-white beneath. The young become white in the autumn of the first year, but assume their winter colouring a little later in the season than the adults. We have met with some specimens in the New York markets, late in January, in which the change of colour was very partial, the summer pelage still predominating.

DIMENSIONS.

The size and weight of the northern hare we have found to vary very much. The measurements hitherto given were generally taken from stuffed specimens, which afford no very accurate indications of the size of the animal when living or when recently killed. Dr. Godman, on the authority of Prince Charles Lucien Bonaparte, gives the measurement of a recent specimen as thirty-one inches, and Dr. Harlan's measurement of the same specimen after it had been stuffed was sixteen inches. We think it probable that the Prince and the Doctor adopted different modes of measuring. All stuffed specimens shrink very much; of a dozen now in our collection, there is not one that measures more than eighteen inches, from point of nose to root of tail, and several white adults measure but fifteen inches.

The following measurements are from the largest specimen we have procured, taken when the animal was recently killed:

From point of nose to root of tail . . .	$19\frac{1}{4}$ inches.
Tail (vertebræ)	$1\frac{1}{4}$ "
Do., to end of hair	$2\frac{1}{4}$ "
From heel to end of middle claw . . .	$5\frac{1}{2}$ "
Height of ear	$3\frac{1}{2}$ "
Another specimen of moderate size.	
From point of nose to root of tail . . .	16 "
Tail (vertebræ)	$1\frac{1}{2}$ "
Do., to end of hair	$2\frac{1}{2}$ "
From heel to end of middle claw . . .	$5\frac{1}{4}$ "
Height of ear	$3\frac{1}{2}$ "

Weight.—This species in the beginning of winter varies from three to six and a-half pounds, but we consider $5\frac{1}{2}$ pounds to be the average weight of a full-grown animal in good condition.

HABITS.

Our different species of hares, and more especially the present one and the little gray rabbit, have been so much mixed up in the accounts of authors that great confusion exists in regard to their habits, and their specific identity. The assertion of Warden, that the American hare retreats into hollow trees when pursued, applies to the gray rabbit, for which it was no doubt intended, but not to the northern hare. We are not aware that the latter ever takes shelter either in a hole in the earth or in a hollow tree. We have seen it chased by hounds for whole days, and have witnessed the repetition of these hunts for several successive winters, without ever knowing it to seek concealment or security in such places. It depends on its long legs, and on the thickness of the woods, to aid it in evading the pursuit of its enemies. When hunted, it winds and doubles among thick clusters of young pines and scrub-oaks, or leads the dogs through entangled patches of hemlock and spruce fir, until it sometimes wearies out its pursuers; and unless the hunter should appear, and stop its career with the gun, it is almost certain to escape.

In deep snows, the animal is so light, and is so well supported by its broad furry-feet, that it passes over the surface making only a faint impression, whilst the hounds plunge deep into the snow at every bound, and soon give up the hopeless pursuit. It avoids not only open grounds, but even open woods, and confines itself to the densest and most impenetrable forests. Although it wanders by night in many directions in search of its appropriate food, we have scarcely ever seen its tracks in the open fields; it seems, cautiously to avoid the cabbage and turnip fields of the farmer, and seldom even in the most retired places makes an encroachment on his cultivated grounds.

The food of this species in summer consists of various kinds of juicy and tender grasses, and the bark, leaves, and buds, of several small shrubs; and these hares seem to be particularly fond of the young twigs of the wild allspice, (*Laurus benzoin*,) but in winter, when the earth is covered with snow, they gain a precarious subsistence from the buds and bark of such trees as are suited to their taste. Sometimes they scratch up the snow to feed on the leaves and berries of the various species of *Pyrola* found in the Northern States. The bark of the willow, birch, and poplar, and the buds of young pines, are sought after by them with avidity. We have seen persons in the northern part of the State of New York, who were desirous of shooting these animals by moonlight, watching near American black-poplar trees, (*Populus Hudsonica*,) which they had cut down for the purpose of attracting them to feed on their buds and tender twigs, in which they were often successful. Some of these hares which we had in a domesticated state, were fed on cabbage leaves, turnips, parsnips, potatoes, and sweet apples. During one very cold winter, when these could not be conveniently obtained, they were frequently supplied with clover-hay, to which, when more agreeable food was not given them, they did not evince any aversion; from time to time also, outer branches of willow, poplar, or apple trees, were thrown into their enclosure, the bark of which seemed to be greatly relished by them.

The northern hare, like most others of the genus, seeks its food only by night or in the early part of the evening. To this habit it is more exclusively confined during autumn and winter than in spring and summer. In the latter seasons, especially in spring, these animals are frequently observed in the morning, and as the sun is declining, in the afternoon, cautiously proceeding along some solitary by-path of the forest. Two or three may often be seen associated together, appearing full of activity and playfulness. When disturbed on these occasions, they stamp on the ground, making a noise so loud that it can be heard at some distance, then hopping a few yards into the thicket, they sit with ears erect, seemingly listening, to ascertain whether they are pursued or not. This habit of thumping on the earth is common to most hares and rabbits. We have particularly noticed it in the domesticated rabbit, (*L. cuniculus*,) and in our common gray rabbit. They are more particularly in the habit of doing it on moonlight nights; it is indicative either of fear or anger, and is a frequent action among the males when they meet in combat. During cold weather this hare retires to its form at early dawn, or shelters itself under the thick foliage of fallen tree tops, particularly those of the pine and hemlock. It occasionally retires to the same cover for a number of nights in succession, but this habit is by no means common; and the sportsman who expects on some succeeding day to find this animal in the place from which it was once started is likely to be disappointed; although we are not aware that any other of our species of hare are so attached to particular and beaten paths through the woods, as the one now under consideration. It nightly pursues these paths, not only during the deep snows of winter, but for a period of several years, if not killed or taken, wandering through them even during summer. We have seen a dozen caught at one spot, in snares composed of horse-hair or brass wire, in the course of a winter, and when the snow had disappeared, and the spring was advanced, others were still captured in the same way, and in the same paths.

The period of gestation in this species is believed to be, (although we cannot speak with positive certainty,) about six weeks. Two females which we domesticated, and kept in a warren, produced young, one on the tenth and the other on the fifteenth of May; one had four, and the other six leverets, which were deposited on a nest of straw, the inside of which was lined with a considerable quantity of hair plucked from their bodies. They succeeded in rearing all their young but one, which was killed by the male of a common European rabbit. They were not again gravid during that season. Ill health, and more important studies, required us to be absent for six months, and when we returned, all our pets had escaped to the woods, therefore we could not satisfactorily finish the observations on their habits in confinement, which had interested and amused us in many a leisure hour.

We, however, think it probable that the females in their wild state may produce young twice during the season. Those referred to above were much harassed by other species which were confined in the same warren, and might therefore have been less prolific than if they had enjoyed their liberty undisturbed, amid the recesses of their native woods. We have frequently observed the young of the northern hare in May, and again in July. These last must have been either from a second litter, or the produce of a young female of the previous year. The young at birth were able to see. They were covered with short hair; and appeared somewhat darker in colour than the adults, at that season. They left their nest in ten or twelve days, and from that time seemed to provide for themselves, and to derive little sustenance or protection from their mothers. The old males at this period seemed to be animated with renewed courage; they had previously suffered themselves to be chased and worried by the common English rabbit, and even retreated from the attacks of the gray rabbit; but they now stood their ground, and engaged in fierce combats with the other prisoners confined with them, and generally came off victorious. They stamped with their feet, used their teeth and claws to a fearful purpose, and in the fight, tore off patches of skin, and mutilated the ears of their former persecutors, till they were left in undisturbed possession of the premises!

The males did not evince the vicious propensity to destroy their young, which is observed in the domesticated English rabbit; on the contrary, they would frequently sit beside their little family, when they were but a day or two old, seeming to enjoy their playfulness, and to watch their progress to maturity.

The northern hare seems during summer to prefer dry and elevated situations, and to be more fond of grounds covered with pines and firs than of those that are overgrown with oak or hickory. The swamps and marshes soil their feet, and after having been compelled to pass through them, they are for hours employed in rubbing and drying their paws. In winter, however, when such places are hardened by the frost, they not only have paths through them in every direction, but occasionally seek a fallen tree top as a hiding or resting place, in the centre of a swamp. We have observed them in great numbers in an almost impenetrable thicket of black larch, or hackmatack, (*Larix pendula*,) considerable portions of which were during summer a perfect morass. In what are called the "bark clearings," places where hemlock trees have been cut down to procure tan bark, this species is sometimes so abundant that twenty or thirty of them may be started in a day's walk.

As an article of food, this is the most indifferent of all our species of hares; its flesh is hard, dry, almost juiceless, possessing none of the flavour of the English hare, and much inferior to that of our gray rabbit. Epicures, however, who often regard as dainties dishes that are scarce, and who, by the skilful application of the culinary art, possess means of rendering things savoury that are of themselves insipid, may dispute this point with us.

The northern hare, as is proverbially the case with all the species, has many enemies. It is pursued by men and dogs, by carniverous beasts of the forest, by eagles, by hawks, and by owls. In the northern parts of Maine, in Canada, and in the countries farther north, their most formidable enemies are the Canada lynx (*Lynx Canadensis,*) the jer falcon (*Falco Islandicus,*) and the snowy owl (*Surnea nyctea.*) In the New England States, however, and in New York, the red-tailed hawk, (*Burteo borealis*) is occasionally seen with one of these species in its talons. But its most formidable enemy is the great horned owl (*Bubo Virginianus.*) We have also, on one occasion, observed a common house-cat dragging a full-grown northern hare from the woods, to feed her young. Lads on their way to school entrap them with snares attached to a bent twig, placed along the paths they nightly resort to. The hunter finds recreation in pursuing them with hounds, whilst he places himself in some wood-path where they were last seen to pass. The hare runs from fifty to a hundred yards ahead of the dogs, and in its windings and turnings to escape from them frequently returns to the spot where the hunter is stationed, and falls by a shot from his gun.

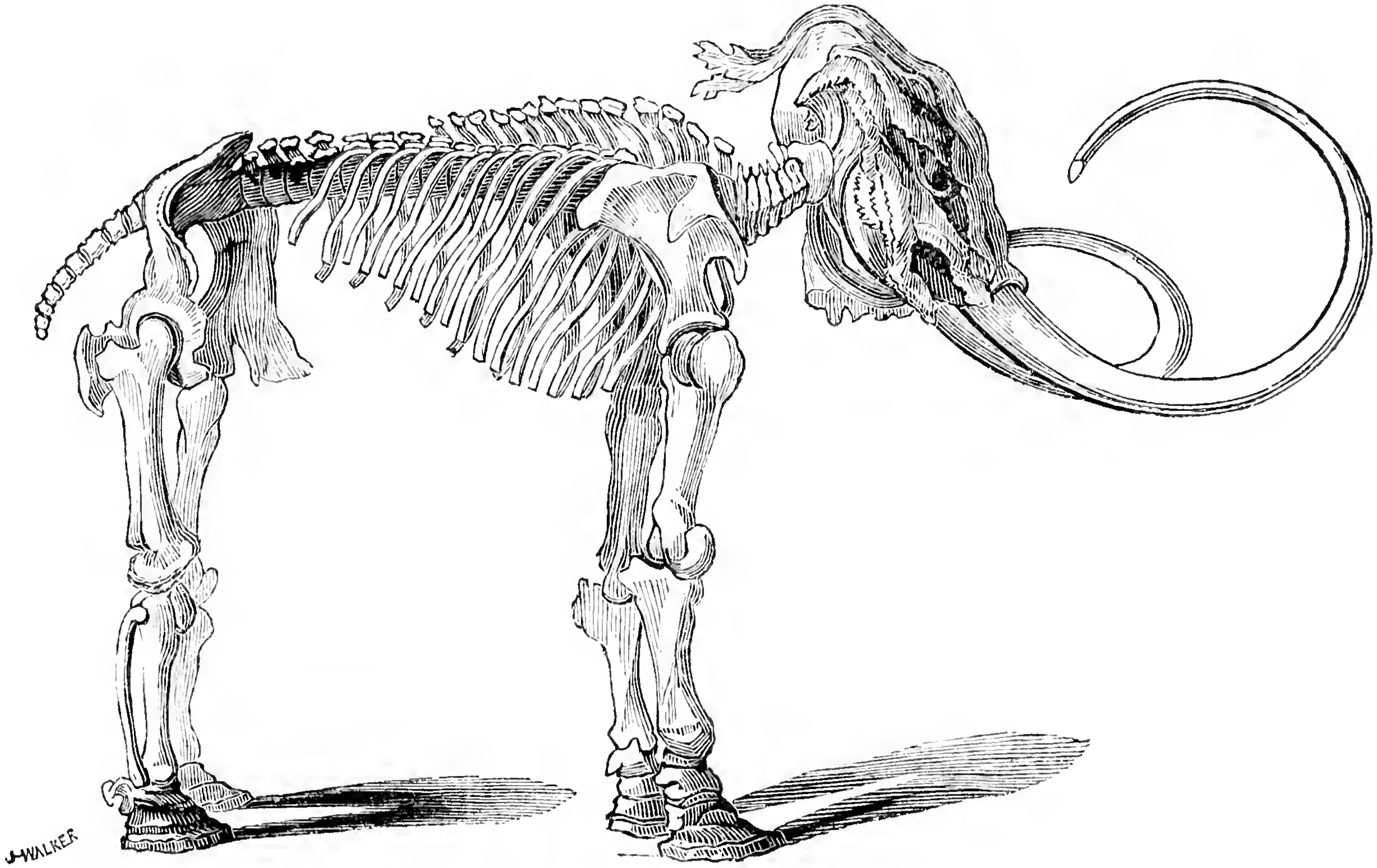
The northern hare, when rapidly pursued, makes such great efforts to escape that the poor creature (as we have said already) is occasionally successful, and fairly outruns the hounds, whilst the hunter is cunningly avoided by it when doubling. After one of these hard chases, however, we have known the animal die from the fatigue it had undergone, or from having been overheated. We once saw one which had been closely pressed by the dogs nearly all the afternoon, return to a thicket after the hounds had been called off, and the sportsmen had given up the vain pursuit. Next morning we examined the place it had retired to, and to our surprise, discovered the hare sitting in its form, under a dwarfish, crooked, pine-bush; it was covered with snow, and quite dead. In this instance the hare had no doubt been greatly overheated by the race of the preceding day, as well as exhausted, and terrified; and the poor thing, being in that condition very susceptible of cold, was probably chilled by the night air and the falling snow, until its palpitating heart, gradually impelling the vital fluid with fainter and slower pulsations, at length ceased its throbbings forever.

Sometimes we have found these hares dead in the woods after the melting of the snow in the spring, and on examination we found they were entangled in portions of wire snares, frequen tly, entwined round their necks; from which they had been unable to extricate themselves.

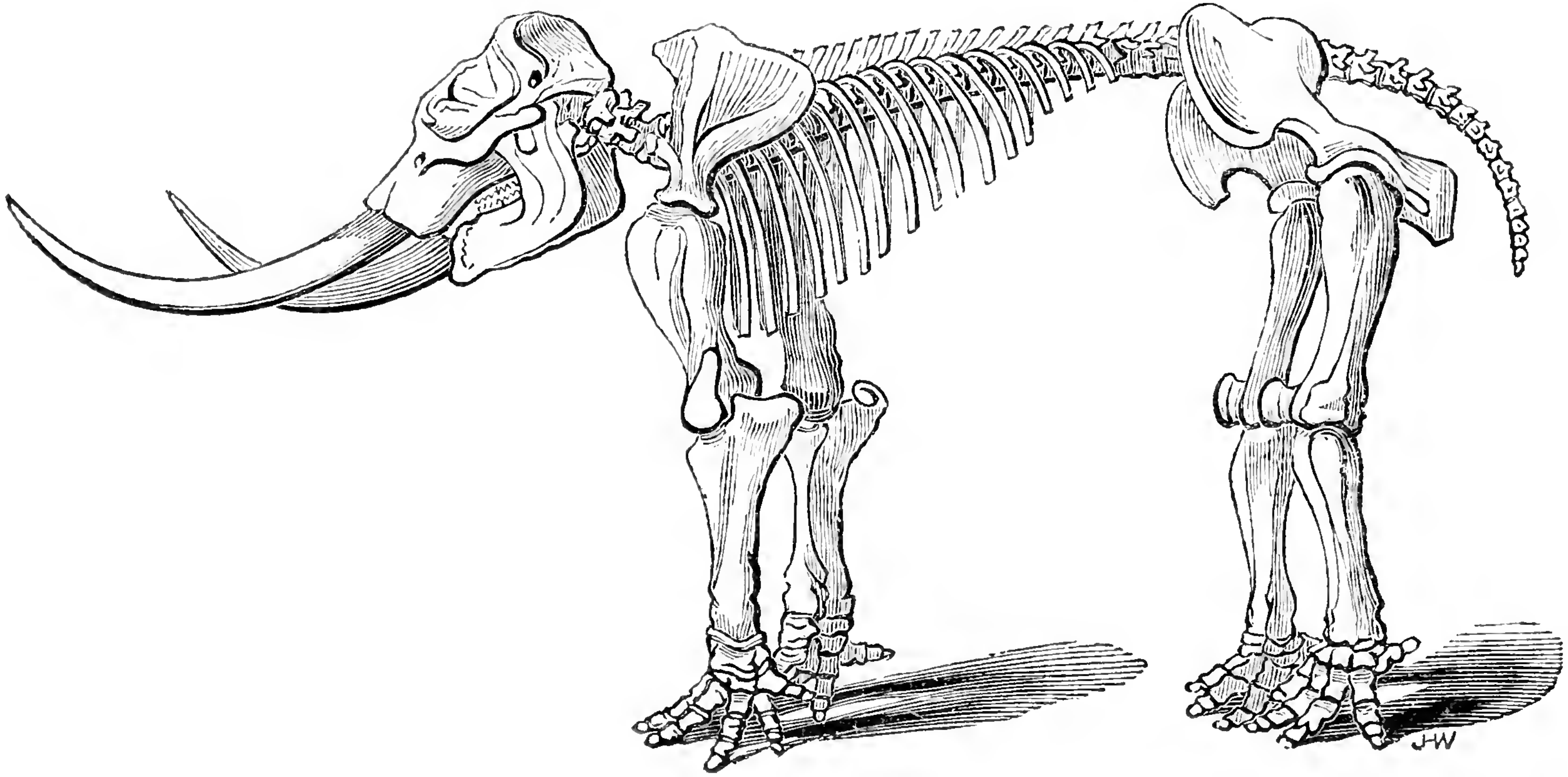
This species when caught alive cannot be taken into the hand› ike the gray rabbit, with impunity; the latter, when seized by the ears or hind-legs; soon becomes quiet, and is harmless; but the northern hare struggles to escape, and makes a formidable resistance with its teeth and nails. On one occasion a servant who was exp ert at catching the gray rabbit in traps, came to us with a rueful countenance, holding a hare in his hands, exhibiting at the same time sundry severe scratches he had received, showing us his torn clothes, and a place on his leg which the animal had bitten, and declaring that he had caught " a rabbit as cross as a cat." We ascertained it to be a northern hare, in its summer dress, and although its captor had not been able to distinguish it from the gray rabbit by its colour, he certainly had had a practical lesson in natural history, which he did not soon forget.

A living individual of this species, which we have in Charleston in a partially domesticated state, for the purpose of trying to ascertain the effect of a warm climate on its changes of colour, is particularly cross when approached by a stranger. It raises its fur, and springs at the intruder with almost a growl, and is ready with its claws and teeth to gratify its rage, and inflict a wound on the person who has aroused its ire. When thus excited, it reminded us, by its attitudes, of an angry raccoon.

The skin of the northern hare is so tender and easily torn, and the fur is so apt to be spoiled and drop off on being handled, that it is difficult to prepare perfect specimens for the naturalist's cabinet. The pelt is not in much request among the furriers, and is regarded by the hatter as of little value. The hind-feet, however, are used by the latter in a part of the process by which the soft, glossy, surface is imparted to his fabric, and answer the purpose of a soft hair-brush.



THE MAMMOTH.—(See page 379.)



THE MASTODON.—(See page 379.)

This species is found in portions of the British possessions, as far as the sixty-eighth parallel of north latitude. It is, however, confined to the eastern portion of our Continent; RICHARDSON, who represents it as "a common animal from one extremity of the Continent to the other," seems to have mistaken for it another species which replaces it on the north-west coast. Although it does not range as far to the north as the polar hare, it is decidedly a northern species; it is found at Hudson's Bay, in Newfoundland, Canada, all the New England States, and in the northern portions of New York, Pennsylvania, and Ohio. Mr. DOUGHTY informed us that he had procured a specimen on the Alleghany Mountains in the northern part of Virginia, Lat. 40°′ 29, where it had never before been observed by the inhabitants. On seeking for it afterwards in the locality from which he obtained it, we were unsuccessful, and we are inclined to believe that it is only occasionally that some straggler wanders so far south among these mountains, and that its southern limit may be set down at about 41°.

ARTICLE LIV.—*On the Mammoth and the Mastodon.* *

The enormous bones of extinct elephantoid animals found in America belong to two species: the Mammoth, *Elephas primigenius*, and the Mastodon, *M. giganteus*, or *Ohioticus*. We have figured their skeletons on the plate which will be found at the commencement of this number.

The mammoth was a true elephant, but of a species different from either of the two at present existing; and, it appears, was fitted to endure the rigours of a climate of greater severity than that of Canada, as its bones are found abundantly from latitude 40° north to the Arctic circle. In Siberia and Russian America they occur in vast quantities, imbedded, in some instances, in ice which has never thawed since that remote period when these gigantic creatures lived. In the extract from Professor Owen's British Fossil Mammalia and Birds, which we shall give in this article, will be found an interesting account of the famed discovery of a mammoth with the flesh preserved. It is unfortunate that this specimen could not have been preserved entire, and placed in some museum, there to remain so long as the human

* See Plates 5 and 6.

race shall be permitted to exist on this planet. No merely terrestrial object ever seen by man could possess a thousandth part of the sublime interest that would be excited by this sole survivor in the flesh of a lost world of life.

The mammoth differs from the elephants of our day only specifically, or as much, perhaps, as the grizzly bear differs from the black bear; but the mastodon was of another, though closely allied, genus, principally characterized by the form of the molar teeth, which had the grinding surface provided with a number of conical protuberances, while the same surface of the tooth of the mammoth was flat, and crossed by narrow jagged ridges. The mastodon had shorter legs, a longer body, and was more bulky than the mammoth, although not so tall. It appears that both were larger than the largest Asiatic elephant, none of which exceed 10 feet in height, while a skeleton of ordinary size of the mastodon is 9½ feet. That figured on our plate is 9 feet 7 inches high and 20 feet long, as it stands in the British museum; and on the same platform, Dr. Mantell says, "there are five bones of the fore-foot nearly twice as large, in linear dimensions, as the corresponding parts of the above skeleton, of *Elephas meridionalis*, dug up in the brick-fields at Gray's, in Essex." The mammoth figured is 9 feet 4 inches high and 16 feet 4 inches long, without including the tusks, which are 9 feet 6 inches long.

The bones of these great extinct animals have been found in hundreds of places in the west, but appear to be totally wanting in the eastern part of America. Some of them have been exhumed in Canada within the last few years. In the collection of the Geological Survey at Montreal are two tusks and a portion of the lower jaw of the mammoth discovered at Hamilton in 1851, at Burlington Heights, thirty feet beneath the surface.

The locality was thus described in a letter we received from Mr. McQueen, editor of the *Huron Signal*, upon the subject:—

"Burlington Heights is a narrow peninsula, about three-fourths of a mile in length, and not more than half a furlong in width, which divides Burlington Bay and the Desjardines Marshes; an area of several thousand acres lying between the head of the bay and the town of Dundas, four miles distant. The marsh is still partially covered with water, and recent experiments have shown that the bottom is a soft floating mud, extending to a depth of 80 feet. Its present surface is scarcely above the waters of the bay. A sluggish stream from the high lands crawls down its centre, and in a deep narrow gulf winds round the head of the peninsula into the bay, and now forms the Desjardines Canal. I have no doubt that the large mass of alluvial matter has been formed by the stream in its untiring perseverance. The peninsula is 110 feet in height. The land on each side of the amphitheatre in which the marsh is enclosed rises to a great height, say 150 feet above the level of the peninsula. The great puzzle to me is the cemented gravel; it begins at the surface, is 30 feet thick, is regularly bedded, like the strata in a limestone quarry, has a considerable dip, or inclination, and is all but impenetrable. It is as difficult to drill or blast as any limestone. The sand on which it is incumbent is too clean and too fine for building purposes; of this quality it continues for perhaps 30 feet downwards, and then turns into a loose, coarse gravel, like the beach of the lake. The bones were deposited in the fine sand, in which there was not a vestige of a shell of any description."

The most celebrated locality for these fossils is at Big Bone Lick, in Kentucky, where it is said the remains of not less than one hundred mastodons and twenty mammoths, with bones of the megalonyx, stag, horse and bison, have been discovered.

With respect to the time when the mammoth and mastodon became extinct, we have not the slightest evidence of their existence within the human period, although there is sufficient proof that they existed immediately before the advent of man. The Indians have a tradition bearing upon these remains, of which we find the following account in an old magazine, "The Bee," published December, 1791:—

Of the Enormous Bones found in America.

Between thirty and forty years ago, at a salt lick near the banks of the Ohio, the remains of several skeletons were discovered, which demonstrate the former existence of animals very far surpassing in size any at present known. There is now in the museum at *Yale* College teeth of a monstrous magnitude, sent thither from *Muskingum* by the late General Parsons. The one which the writer of this account saw was upwards of fifteen inches in circumference, and, including its fangs, twelve or thirteen inches in length.

In the year 1783, as a labourer was ditching a bog-meadow, belonging to a clergyman at Little Breton, in Ulbster county, he found a mass of bones, not two feet beneath the surface of the ground, of the same kind, probably, with those observed at the Ohio; they were of a black colour, but very hard, and the shape perfect. A German physician, then with the army at New York, just before its departure, procured and took them all to Europe. Gentlemen of the first character in this country saw them, and declare that they were astonishingly large. The thigh bone in particular, a gentleman measured, and found it thirty-five inches in circumference.

It is impossible to arrive at the knowledge of the magnitude of an animal from an imperfect skeleton; but no one can hesitate supposing that the most gigantic quadrupeds at present known are mere pigmies compared to some of the former tenants of our western world; but of these, perhaps nothing more will ever be discovered than the memorials above related, and the following tradition existing among the natives. It is given in the very terms of a Shawnee Indian, to shew that the impression has been most forcible:

" Ten thousand moons ago, when nought but gloomy forests covered this land of the sleeping sun, long before pale men, with thunder and fire at their command, rushed on the wings of the wind to ruin this garden of nature, when nought but the untamed wanderers of the woods, and men as unrestrained as they were the lords of the soil, a race of animals were in being, huge as the frowning precipice, cruel as the bloody panther, swift as the descending eagle, and terrible as the angel of night. The pines crashed beneath their feet, and the lake shrunk when they slaked their thirst; the forceful javelin in vain was hurled, and the barbed arrow fell harmless from their side. Forests were laid waste at a meal, the groans of expiring animals were every where heard; and whole villages inhabited by man were destroyed in a moment. The cry of universal distress extended even to the region of peace in the West, and the good spirit interposed to save the unhappy. The forked lightening gleamed all aronnd, and loudest thunder rocked the globe. The bolts of heaven were hurled upon the cruel destroyers alone, and the mountains echoed with the bellowings of death. All were killed except one male, the fiercest of the race, and him even the artillery of the sky assailed in vain. He ascended the highest summit which shades the source of the *Monongahela*, and, roaring aloud, bid defiance to every vengeance The red lightening scorched the lofty firs, and rived the knotty oaks, but only glanced upon the enraged monster. At length maddened with fury, he leaped over the waves of the west at a bound, and this moment reigns the uncontroled monarch of the wilderness, in despite of even Omnipotence itself."

The following is from the work of Professor Owen, above referred to:

The remains of the mammoth occur on the Continent, as in England, in the superficial deposits of sand, gravel, and loam, which are strewed over all parts of Europe; and they are found in still greater abundance in the same formations of Asia, especially in the higher latitudes, where the soil which forms their matrix is perennially frozen.* Remains of the mammoth have been found in great abundance in the cliffs of frozen mud on the east side of Behring's Straits, in Eschscholtz's Bay, in Russian America, lat. 66° N.; and they have been traced, but in scantier quantities, as far south as the States of Ohio, Kentucky, Missouri, and South Carolina. But no authentic relics of the *Elephas primigenius* have yet been discovered in tropical latitudes,† or in any part of the southern hemisphere. It would thus appear that the primeval elephants formerly ranged over the whole northern hemisphere of the globe, from the 40th to the 60th and possibly to near the 70th degree of latitude. Here, at least, at the mouth of the River Lena, the carcass of a mammoth has been discovered, preserved entire, in the icy cliffs and frozen soil of that coast. To account for this extraordinary phenomenon, geologists and naturalists, biassed more or less by the analogy of the existing elephants, which are restricted to climes where the trees flourish with perennial foliage, have had recourse to the hypothesis of a change of climate in the northern hemisphere, either sudden, and due to a great geological cataclysm,‡ or gradual, and brought

* Hedenstrom, in his "Survey of the Laechow Islands," on the north-eastern coast of Siberia, remarks that the first of these islands is little more than one mass of these bones; and that although the Siberian traders have been in the habit of bringing over large cargoes of them (tusks) for upward of sixty years, yet there appears to be no sensible diminution.

† The fossil elephantine remains discovered in India belong to a species more nearly allied to the *Elephas Indicus.*

‡ Cuvier, 'Discours sur les Révolutions de la Surface du Globe.' It is obvious that the frozen mammoth at the mouth of the Lena forms one of the strongest as well as the most striking of the celebrated anatomist's assumed "proofs that the revolutions on the earth's surface had been sudden." Cuvier affirms that the mammoth could not have maintained its existence in the low temperature of the region where its carcass was arrested, and that at the moment when the beast was destroyed, the land which it trod became glacial. "Cette gelée éternelle n'occupait pas auparavant les lieux où ils ont été saisis; car ils n'auraient pas pu vivre sous une pareille température. C'est donc le même instant qui a fait périr les animaux, et qui a

about by progressive alternations of land and sea.*

I am far from believing that such changes in the external world were the cause of the ultimate extinction of the *Elephas primigenius;* but I am convinced that the peculiarities in its ascertained organization are such as to render it quite possible for the animal to have existed as near the pole as is compatible with the growth of hardy trees or shrubs. The fact seems to have been generally overlooked, that an animal organized to gain its subsistence from the branches or woody fibre of trees, is thereby rendered independent of the seasons which regulate the development of leaves and fruit; the forest-food of such a species becomes as perennial as the lichens that flourish beneath the winter snows of Lapland; and, were such a quadruped to be clothed, like the reindeer, with a natural garment capable of resisting the rigours of an Arctic winter, its adaptation for such a climate would be complete. Had our knowledge of the mammoth, indeed, been restricted, as in the case of almost every other extinct animal, to its bones and teeth, it would have been deemed a hazardous speculation to have conceived, *a priori*, that the extinct ancient elephant, whose remains were so abundant in the frozen soil of Siberia, had been clad, like most existing quadrupeds adapted for such a climate, with a double garment of close fur and coarse hair; seeing that both the existing species of elephant are almost naked, or, at best, scantily provided when young with scattered coarse hairs of one kind only.

The wonderful and unlooked for discovery of an entire mammoth, demonstrating the Arctic character of its natural clothing, has, however, confirmed the deductions which might have been legitimately founded upon the localities of its most abundant remains, as well as upon the structure of its teeth, viz., that, like the reindeer and musk ox of the present day, it was capable of existing in high northern latitudes.

The circumstances of this discovery have been recorded by Mr. Adams, in the 'Journal du Nord,' printed at Petersburg in 1807, and in the 5th volume of the 'Memoirs of the Imperial Academy of Sciences at St. Petersburg,' of which an excellent English translation was published in 1819.

rendu glacial le pays qu'ils habitaient. Cet événement a été subit, instantané, sans aucune gradation, &c."—Ossemens Fossiles, 8vo. ed., 1834, tom. i., p. 108.

* Lyell, 'Principles of Geology,' in which the phenomena that had been supposed "to have banished for ever all idea of a slow and gradual revolution,"† were first attempted to be accounted for by the gradual operation of ordinary and existing causes.

† Jameson's 'Cuvier's Theory of the Earth,' 8vo., 1813, p. 16.

Schumachoff, a Tungusian hunter and collector of fossil ivory, who had migrated in 1799 to the peninsula of Tamut, at the mouth of the River Lena, one day perceived amongst the blocks of ice a shapeless mass, not at all resembling the large pieces of floating wood which are commonly found there. To observe it nearer, he landed, climbed up a rock, and examined this new object on all sides, but without being able to discover what it was. The following year he perceived that the mass was more disengaged from the blocks of ice, and had two projecting parts. Towards the end of the next year (1801,) the entire side of the animal, and one of its tusks, were quite free from the ice. On his return to the borders of the Lake Oncoul, he communicated this extraordinary discovery to his wife and some of his friends, but their reception of the news filled him with grief. The old men related how they had heard their fathers say that a similar monster had been formerly discovered on the same peninsula, and that all the family of the person who discovered it had died soon afterwards. The mammoth was consequently regarded as an augury of future calamity, and the Tungusian was so much alarmed that he fell seriously ill; but becoming convalescent, his first idea was the profit he might obtain by selling the tusks of the animal, which were of extraordinary size and beauty. The summer of 1802 was less warm and more stormy than usual, and the icy shroud of the mammoth had scarcely melted at all. At length, towards the end of the fifth year (1803,) the desires of the Tungusian were fulfilled; for, the part of the ice between the earth and the mammoth having melted more rapidly than the rest, the plane of its support became inclined, and the enormous mass fell by its own weight on a bank of sand. Of this, two Tungusians, who accompanied Mr. Adams, were witnesses. In the month of March, 1804, Schumachoff came to his mammoth, and having cut of the tusks, exchanged them with a merchant, called Bultunoff, for goods of the value of fifty rubles.

Two years afterwards, or the seventh after the discovery of the mammoth, Mr. Adams visited the spot, and "found the mammoth still in the same place, but altogether mutilated. The prejudices being dissipated because the Tungusian Chief had recovered his health, there was no obstacle to prevent approach to the carcass of the mammoth; the proprietor was content with his profit from the tusks; and the Jakutski of the neighbourhood had cut off the flesh, with which they fed their dogs during the scarcity. Wild beasts, such as white bears, wolves, wolverenes, and foxes, also fed upon it, and the traces of their footsteps were seen around." The skeleton, almost entirely cleared of its flesh, remained whole, with the exception of one fore-leg, (probably dragged off by the bears.) The spine, from the skull to the os coccygis, one scapula, the pelvis, and the three remaining extremities, were still held together by the ligaments, and by parts of the skin. The head was covered with a dry skin; one of the ears, well preserved, was furnished with a tuft of hair. The point of the lower lip had been gnawed; and the upper one, with the proboscis, having been devoured, the molar teeth could be perceived. The brain was still in the cranium, but appeared dried up. The parts least injured were one fore-foot and one hind-foot; they were covered with skin, and had still the sole attached. According to the assertion of the Tungusian discoverer, the animal was so fat that its belly hung down below the joints of the knees. This mammoth was a male, with a long mane on the neck; the tail was much mutilated, only eight, out of twenty-eight or thirty caudal vertebræ, remaining; the proboscis was gone, but the places of the insertion of its muscles were visible on the skull. The skin, of which about three-fourths was saved, was of a dark gray colour, covered with a reddish wool, and coarse long black hairs. The dampness of the spot where the animal had lain so long had in some degree destroyed the hair. The entire skeleton, from the fore part of the skull to the end of the mutilated tail, measured sixteen feet four inches; its height was nine feet four inches. The tusks measured along the curve nine feet six inches, and in a straight line from the base to the point three feet seven inches.

Mr. Adams collected the bones, and had the satisfaction to find the other scapula, which had remained not far off. He next detached the skin on the side on which the animal had lain, which was well preserved; the weight of the skin was such that ten persons found great difficulty in transporting it to the shore. After this, the ground was dug in different places, to ascertain whether any of its bones were buried, but principally to collect all the hairs, which the white bears had trod into the ground while devouring the flesh, and more than thirty-six pounds' weight of hair were thus recovered. The tusks were repurchased at Jatusk, and the whole expedited thence to St. Petersburg; the skeleton is now mounted in the museum of the Petropolitan Academy, as it is represented in the plate.*

It might have been expected that the physiological consequences deducible from the organization of the extinct species, which was thus, in so unusual a degree, brought to light, would have been at once pursued to their utmost legitimate boundary, in proof of the adaptation of the mammoth to a Siberian climate; but, save the remark that the hairy covering of the mammoth must have adapted it for a more temperate zone than that assigned for existing elephants,† no further investigations of the relation of its organization to its habits, climate, and mode of life, appear to have been instituted; they have in some instances, indeed, been rather checked than promoted.

Dr. Fleming has observed that "no one acquainted with the gramineous character of the food of our fallow-deer, stag, or roe, would have assigned a lichen to the reindeer." But we may readily believe that any one cognizant of the food of the elk, might be likely to have suspected cryptogamic vegetation to have entered more largely into the food of a still more northern species of the deer tribe. And I can by no means subscribe to another proposition by the same eminent naturalist, that "the kind of food which the existing species of elephant prefers will not enable us to determine, or even to offer a probable conjecture concerning that of the extinct species." The molar teeth of the elephant possess, as

* A part of the skin, and some of the hair of this animal, were sent by Mr. Adams to Sir Joseph Banks, who presented them to the museum of the Royal College of Surgeons. The hair is entirely separated from the skin, excepting in one small part, where it still remains firmly attached. It consists of two sorts, common hair and bristles, and of each there are several varieties, differing in length and thickness. That remaining fixed on the skin is thick-set and crisply curled; it is interspersed with a few bristles, about three inches long, of a dark reddish colour. Among the separate parcels of hair are some rather redder than the short hair just mentioned, about four inches long, and some bristles nearly black, much thicker than horse-hair, and from twelve to eighteen inches long. The skin, when first brought to the Museum, was offensive to the smell. It is now quite dry and hard, and where most compact is half an inch thick. Its colour is the dull black of the living elephants.

† La longue toison dont cet animal était couvert semblerait même démontrer qu'il était organisé pour supporter un degré de froid plus grand que celui qui convient à l'éléphant de l'Inde." Pictet, Paléontologie, 8vo., tom. i., 1844, p. 71.

we have seen, a highly complicated and a very peculiar structure, and there are no other quadrupeds that derive so great a proportion of their food from the woody fibre of the branches of trees. Many mammals browse the leaves; some small rodents gnaw the bark; the elephants alone tear down and crunch the branches the vertical enamel-plates of their huge grinders enabling them to pound the tough vegetable tissue and fit it for deglutition. No doubt the foliage is the most tempting, as it is the most succulent part of the boughs devoured; but the relation of the complex molars to the comminution of the coarser vegetable substance is unmistakeable. Now, if we find in an extinct elephant the same peculiar principle of construction in the molar teeth, but with augmented complexity, arising from a greater number of the triturating plates and a greater proportion of the dense enamel, the inference is plain that the ligneous fibre must have entered in a larger proportion into the food of such extinct species. Forests of hardy trees and shrubs still grow upon the frozen soil of Siberia, and skirt the banks of the Lena as far north as latitude 60°. In Europe arboreal vegetation extends ten degrees nearer the pole, and the dental organization of the mammoth proves that it might have derived subsistence from the leafless branches of trees, in regions covered during a great part of the year with snow.

We may therefore safely infer, from physiological grounds, that the mammoth would have found the requisite means of subsistence at the present day, and at all seasons, in the sixtieth parallel of latitude; and, relying on the body of evidence adduced by Mr. Lyell, in proof of increased severity in the climate of the northern hemisphere, we may assume that the mammoth habitually frequented still higher latitudes at the period of its actual existence. "It has been suggested," observes the same philosophic writer, "that, as in our own times, the northern animals migrate, so the Siberian elephant and rhinoceros may have wandered towards the north in summer." In making such excursions during the heat of that brief season, the mammoths would be arrested in their northern progress by a condition to which the reindeer and musk ox are not subject, viz., the limits of arboreal vegetation, which, however, as represented by the dominating shrubs of Polar lands, would allow them to reach the seventieth degree of latitude.*

* In the extreme points of Lapland, in 70° north latitude, the pines attain the height of sixty feet; and at Enontekessi, in Lapland, in 68° 30' north latitude, Von Buck found corn, orchards, and a rich vegetation, at an elevation of 1356 feet above the sea. Lindley, Intr. to Botany, pp. 485, 490.

But, with this limitation, if the physiological inferences regarding the food of the mammoth from the structure of its teeth be adequately appreciated and connected with those which may be legitimately deduced from the ascertained nature of its integument, the necessity of recurring to the forces of mighty rivers, hurrying along a carcass through a devious course, extending through an entire degree of latitude, in order to account for its ultimate entombment in ice, whilst so little decomposed as to have retained the cuticle and hair, will disappear. And it can no longer be regarded as impossible for herds of mammoths to have obtained subsistence in a country like the southern part of Siberia, where trees abound, notwithstanding it is covered during a great part of the year with snow, seeing that the leafless state of such trees during even a long and severe Siberian winter would not necessarily unfit their branches for yielding sustenance to the well-clothed mammoth.

With regard to the extension of the geographical range of the *Elephas primigenius* into temperate latitudes, the distribution of its fossil remains teaches that it reached the fortieth degree north of the equator. History, in like manner, records that the reindeer had formerly a more extensive distribution in the temperate latitudes of Europe than it now enjoys. The hairy covering of the mammoth concurs, however, with the localities of its most abundant remains, in showing that, like the reindeer, the northern extreme of the temperate zone was its metropolis.

Attempts have been made to account for the extinction of the race of northern elephants by alterations in the climate of their hemisphere, or by violent geological catastrophes, and the like extraneous physical causes. When we seek to apply the same hypothesis to explain the apparently contemporaneous extinction of the gigantic leaf eating Megatheria of South America, the geological phenomena of that continent appear to negative the occurrence of such destructive changes. Our comparatively brief experience of the progress and duration of species within the historical period is surely insufficient to justify, in every case of extinction, the verdict of violent death. With regard to many of the larger Mammalia, especially those which have passed away from the American and Australian continents, the absence of sufficient signs of extrinsic extirpating change or convulsion, makes it almost as reasonable to speculate with Brocchi,* on the possibility that

* Cited by Lyell, 'Principles of Geology,' (1835,) vol. iii., p. 104.

species like individuals may have had the cause of their death inherent in their original constitution, independently of changes in the external world, and that the term of their existence, or the period of exhaustion of the prolific force, may have been ordained from the commencement of each species.

ARTICLE LV.—*On the Genus Tellinomya, and allied Genera,* with Illustrations, by Professor JAMES HALL, Palæontologist to the State of New York; written for the CANADIAN NATURALIST AND GEOLOGIST.

In the investigations of Palæozoic fossils, it often happens that the most important parts for the determination of the generic characters are obscured or entirely hidden by the adhering stony matter. This is particularly true of the Gasteropoda and Lamelli branchiata, and the generic characters are often necessarily derived from the external features of the shell. It is not always possible to make these determinations with such accuracy, that further discoveries will not show the necessity of some modification. Were the descriptions of the genera and species of the Lamelli branchiate, shells of the Palæozoic rocks, left until the hinge and teeth, the pallial and muscular impressions, could be determined, comparatively few would be described.

In the first volume of the Palæontology of New York several new genera were proposed, and among them the genus Tellinomya, which is the subject of the present notice. This genus was constituted to include several species, supposed to be related to each other from external characters. These characters were suggestive of *Tellina* and of *Mya*, and the name adopted accordingly.

In the specimens known to me at that time there were no visible teeth or crenulations in the hinge line, and this fact was stated in the description. Subsequently I obtained some specimens which suggested other relations than those indicated by the generic name. No opportunity has occurred of correcting the original description, while in the meantime the species have been referred by Palæontologists to other genera, and in some instances to those of very different character.*

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* M. d'Orbigny refers the species of Tellinomya described in the first volume of the Palæontology of New York to the genus Lyonsia of Turton, a modern shell belonging to a very different family; and to add still more

More recently the extensive collections of the Canada Geological Survey have furnished some beautiful examples, showing in a most perfect manner the structure of the hinge, and the muscular impressions of several species of this genus.

In the meantime, a specimen taken to London by Sir William E. Logan has been noticed as a new genus by Mr. Salter, under the name of Ctenodonta.

The shell upon which Mr. Salter founded this genus is a species of *Tellinomya*, closely allied to the *T. nasuta* of the Trenton limestone. Mr. Woodward, in his "Treatise," places the genus Ctenodonta as synonymous with Isoarca of Munster; while, according to Pictet, it would be placed under the genus Nucula.

The character of the hinge of *Tellinomya nasuta*, and of *T. dubia*, represented in the accompanying figures, show that it bears a close relation to *nucula*, and that it is identical with Ctenodonta.

The shells referable to this type have not the ventricose character, large and often sub-spiral beaks, of *Isoarca;* nor is the beak uniformly anterior, as in that genus. The species of Tellinomya, so far as known, are never cancellated, or otherwise ornamented, beyond the ordinary concentric lines of growth.

Having had an opportunity of examining the hinge, and the internal characters of at least six species, the following characters are deduced therefrom:

Tellinomya.

Generic Characters.—Shell, equivalve, equilateral or sub-equilateral, closed, smooth or marked by lines of growth; ligament, external; hinge line, curved, sometimes sub-angular, with a continuous series of small curved transverse teeth, which diminish from the extremities to the beak, beneath which they are much smaller; muscular impressions, double, two anterior and two posterior, one large and strongly impressed, the other smaller, lying above and

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to the confusion, the same author has placed the species of Modiolopsis also under the genus Lyonsia. In this reference he has been followed by *one* American author.

I may mention here that the collections of the Canada Survey furnish some beautiful exhibitions of the hinge of Modiolopsis, which I hope to have the privilege of illustrating at no distant period.

M. d'Orbigny places *Nucula levata* under the genus Leda, while he leaves the *N. donaciformis* under *Nucula*. Both these shells belong to the genus Tellinomya.

between the larger one and the hinge line; pallial impression, simple.

In the larger species known the hinge line is only slightly arcuate, while among the other species we find many variations

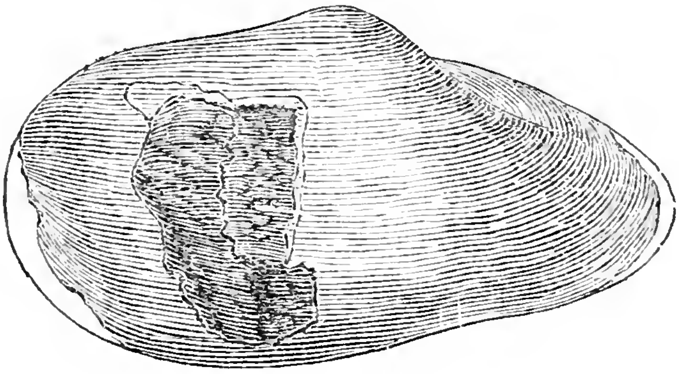

Fig. 1.

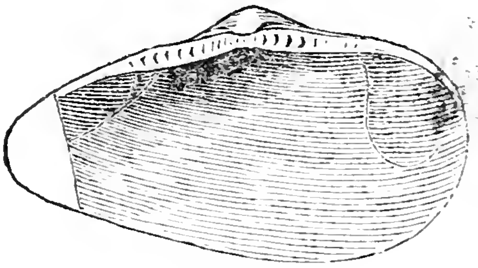

Fig. 2.

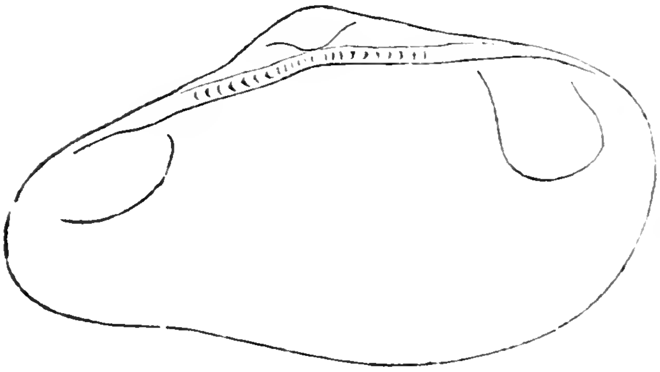

Fig. 3.

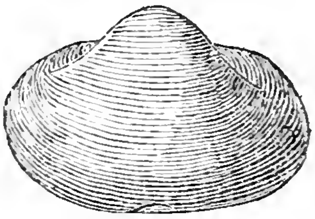

Fig. 4.

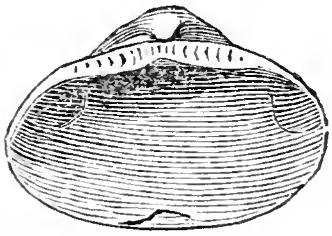

Fig. 5.

Fig. 6.

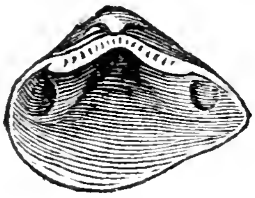

Fig. 7.

Figs. 1, 2, 3.—*Tellinomya nasuta.*
Figs. 4 and 5.—*Tellinomya dubia.*
Figs. 6 and 7.—*Tellinomya cuneata.**

in the curvature, and it sometimes becomes distinctly angular, as in *T. cuneata.* In some species the teeth on either side of the beak curve outwards from it, and in others inwards towards the

* The specimens above figured were collected at Pauquette's Rapids, on the Ottawa River, in beds lying at the junction of the Trenton and Black River limestones. E. B.

beak on both sides. The teeth are often very minute immediately beneath the beaks. The shells of this genus vary from elliptical to ovate and sub-triangular forms, many of them being contracted on the posterior side; they are usually of moderate thickness, though one species is very thick and strong. Some of the species have a distinctly impressed lunule. The lesser muscular impression is often a small pit placed directly beneath the hinge line and between it and the large muscular impression.

The beaks are usually of medium size, pointed, rarely ventricose, approximate or in contact, never subspiral.

The relations of this shell are among the Arcadæ, and approximate to the Nuculæ in their general characters, and to which genus they have usually been referred. They differ from that genus, however, in the absence of the ligamentary pit beneath the beak, and in the presence of an external ligament and double muscular impressions.

It is probable that most of the Palæozoic species referred to the genus *Nucula* belong to Tellinomya, except those of the genus *Nuculites* of Conrad, Cucullella of McCoy, which is distinguished by the presence of a septum in the anterior part of each valve. The place of Tellinomya may be regarded as between Nucula and Nuculites. In external characters it may prove difficult to separate Tellinomya from Nuculites, but the presence of the septum affords nearly the same degree of difference as that between Cucullella and Arca.

The species of the genus Cucullella of McCoy are cited from Upper Ludlow rocks; and the species of the genus Nuculites of Conrad are, with one exception,* from the Hamilton group, or rocks of the same age. We may therefore infer, with some reason, that the shells having crenulate hinge lines, with the internal septum, occur in rocks of later date, or, in other words, that they do not begin their existence before the Upper Silurian or perhaps the Devonian period, while the Tellinomyæ occur among the earliest forms of lamellibranchiate shells.

For the purpose of comparison with Tellinomya, and as exhibiting in some degree similar characters with that genus, as well as to show the marked identity of description in these two genera, I give below the generic characters of *Nuculites* and *Cucullella*, from the descriptions respectively of M. Conrad and Professor McCoy:

* This exception has been found to be destitute of teeth in the hinge.

Genus Nuculites.—Conrad, 1841, Geological Report of New York, page 49.

"Equivalved; hinge, with cardinal teeth, as in Nucula, but apparently uninterrupted beneath the apex; an interior rib like that of Solecurtus, but narrower, extends from the apex, either direct or slightly oblique, towards the base, never passing much beyond the middle of the valve."

"These shells have much the exterior aspect of Nucula, but the deep sinus in casts of some of the species, left by the interior rib, constitutes about the same amount of difference between the two genera as between *Solen* and *Solecurtus*, especially, as I believe to be the case, that the series of cardinal teeth is uninterrupted by a fosset, which in Nucula is a prominent character. This genus, so constituted, is restricted to the Silurian, and perhaps to the Carboniferous system."

Genus Cucullella.—McCoy, Ann. Nat. Hist., 2d series, vol. vii., p. 50. British Pal. Fossils, p. 283, 1855.

"Generic Characters.—Sub-rhomboidal, inequilateral, subequivalve; margin, even; hinge line, entirely crenulated; muscular impressions, two, with a simple pallial scar between them; a strong internal septum extends from before the beaks to the posterior margin of the adductor muscle, forming a deep slit in the casts; surface, generally smooth, or nearly so."

"These Palæozoic shells have been confounded with *Nucula*, (Sow., Phil., &c.,) from which they differ in the absence of the ligamentary pit in the hinge, and in the anterior internal septum; they have also been confounded with *Cucullea*, from which they differ in wanting the hood-like plate of the posterior adductor, and having the septum in the anterior end; and with *Clidophorus*, (Geol. Surv. of Great Britain,) from which they differ in having the hinge crenulated as in *Arca*."

The genus *Lyrodesma* of Conrad was constituted to receive a small shell which occurs in the shales of the Hudson River group, and which, but for certain restrictions in the generic description, might include those here referred to Tellinomya.

Lyrodesma.—Conrad.

Generic Characters.—"Equivalved, inequilateral; hinge line, with eight diverging prominent cardinal teeth, transversely striated."

Mr. Conrad remarks that he "was fortunate enough to obtain two fine casts of this bivalve, with the teeth remarkably well represented." The figure given by Mr. Conrad, to illustrate this fossil, shows the hinge line with a continuous series of eight teeth. The typical species is *L. plana.* I have referred to this genus a small shell from the Utica slate, which is nearly equilateral, with equally rounded extremities, and a few distinct teeth on each side of the beak. This shell, *L. pulchella*, does not differ from Tellinomya, to which it must be referred.

The shells of the genus Tellinomya are shown to differ from Nucula, Isoarca, Nuculites, and Cucullella.

In addition to the species described under this genus in the first volume of the Palæontology of New York, may be added *T.* (*Nucula*) *levata*, *T.* (*Nucula*) *donaciformis*, *T.* (*lyrodesma*) *pulchella;* and also the following species, described by Professor Phillips: (Memoirs Geological Survey of Great Britain, vol. 2.) *Tellinomya* (*Nucula*) *coarctata*, *T.* (*Nucula*) *deltoidea*, *T.* (*Nucula*) *lingualis*, *T.* (*Nucula*) *rhomboidea.*

ARTICLE LVI.—*On American Geological History:*—Address before the American Association for the Advancement of Science, August, 1855, by JAMES D. DANA.*

In selecting a topic for this occasion, I have not been without perplexity. Before an Association for the Advancement of Science,—science in its wide range,—a discourse on the progress of science in America for the past year would seem legitimate. Yet it is a fact that the original memoirs in most departments, published within that period, would make a very meagre list. Moreover, it is too much to expect of any one to roam over others territories, lest he ignorantly gather for you noxious weeds. I have, therefore, chosen to confine myself to a single topic, that of Geology; and I propose, instead of simply reviewing recent geological papers, to restrict myself to some of the general conclusions that flow from the researches of American geologists, and the bearing of the facts or conclusions on geological science. I shall touch briefly on the several topics, as it is a subject that would more easily be brought into the compass of six hours than one. In drawing conclusions among conflicting opinions, or on

* Silliman's American Journal of Science, November, 1856.

points where no opinion has been expressed, I shall endeavor to treat the subject and the views of others in all fairness, and shall be satisfied if those who differ from me shall acknowledge that I have honestly sought the truth.

In the first place, we should have a clear apprehension of the intent or aim of Geological Science. It has been often said, that Geology is a *history*, the records of which are written in the rocks: and such is its highest department. But is this clearly appreciated? If so, why do we find text-books, even the one highest in authority in the English language, written back end foremost,—like a History of England commencing with the reign of Victoria. In history, the phases of every age are deeply rooted in the preceding, and intimately dependent on the whole past. There is a literal unfolding of events as time moves on, and this is eminently true of Geology.

Geology is not simply the science of rocks, for rocks are but incidents in the earth's history, and may or may not have been the same in distant places. It has its more exalted end,—even the study of the progress of life from its earliest dawn to the appearance of man; and instead of saying that fossils are of use to determine rocks, we should rather say that the rocks are of use for the display of the succession of fossils. Both statements are correct; but the latter is the fundamental truth in the science.

From the progress of life, geological time derives its division into Ages, as has been so beautifully exhibited by Agassiz. The successive phases in the progress of life are the great steps in the earth's history. What if in one country the rocks make a consecutive series without any marked interruption between two of these great ages, while there is a break or convenient starting point in another; does this alter the actuality of the ages? It is only like a book without chapters in one case, and with arbitrary sections in another. Again, what if the events characteristic of an age—that is, in Geology, the races of plants or animals—appear to some extent in the preceding and following ages, so that they thus blend with one another? It is but an illustration of the principle just stated, that *time is one*. Ages have their progressive development, flowing partly out of earlier time, and casting their lights and shadows into the far future. We distinguish the ages by the culmination of their grand characteristics, as we would mark a wave by its crest.

Divisions of time *subordinate* to the great ages will necessarily depend on revolutions in the earth's surface, marked by abrupt transitions, either in the organic remains of the region, or in the succession of rocks. Such divisions are not universal. Each continent has its own periods and epochs, and the Geologists of New York and the other States have wisely recognized this fact, disregarding European *stages* or subdivisions. This is as true a principle for the Cretaceous and Tertiory, as for the Silurian and Devonian. The usurpation of Cromwell made an epoch in English annals; not in the French or Chinese. We should study most carefully the records, before admitting that any physical event in America was contemporaneous with a similar one in Europe. The unity in geological history is in the progress of life and in the great physical causes of change, not in the succession of rocks.

The geological ages, as laid down by Agassiz, are the following:—I. The Age of Fishes, including the Silurian and Devonian; II. The Age of Reptiles, embracing from the Carboniferous through the Cretaceous; III. The Age of Mammals, the Tertiary and Post-tertiary; IV. The Age of Man, or the recent era; *fishes* being regarded as the highest and characteristic race of the first age, *reptiles* of the second, and *mammals* of the third.

More recent researches abroad, and also the investigations of Prof. Hall in this country, have shown that the supposed fish remains of the Silurian are probably fragments of Crustacea, if we except those of certain beds near the top of the Silurian; and hence the *Age of Fishes* properly begins with the Devonian. What then is the Silurian? It is pre-eminently the Age of Mollusks.

Unlike the other two Invertebrate sub-kingdoms, the *Radiate* and *Articulate*, which also appear in the earliest fossiliferous beds, the *Molluscan* sub-kingdom is brought out in all its grander divisions. There is not simply the type, but the type analysed or unfolded into its several departments, from the Brachiopods and Bryozoa up to the highest group of all, the Cephalopods. And among these Cephalopods, although they may have been inferior in grade to some of later periods, there were species of gigantic size, the shell reaching a length of ten or twelve feet. The Silurian is therefore most appropriately styled the *Molluscan Age.*

The Palæozoic Trilobites belong to the lower tribe of Crustacea, and Crustacea rank low among Articulates. Moreover, Crustacea (and the Articulata in general) did not reach their fullest development until the Human Era.

The Radiata were well represented in the Silurian periods; but, while inferior to the Mollusca as a sub-kingdom, only corals and crinoids, the lower fixed or vegetative species, with rare exceptions, occur in the Silurian of Molluscan Age.

The Articulata and Radiata thus begin early, but with only the lower forms in each, and neither is a leading class in any age.

Viewing the history, then *zoölogically*, the ages are, the Age of Mollusks, of Fishes, of Reptiles, of Mammals, of Man.

We may now change the point of view to the Vegetable Kingdom. The ages thence indicated would be three :—

I. The *Age of Algæ*, or marine plants, corresponding to the Silurian and Devonian.

II. The *Age of Acrogens*, or flowerless trees, that is, the Lepidodendra, Sigillariæ, and Calamites,—corresponding to the Coal Period and Permian; a name first proposed by Brongniart, and which may still be retained, as it is far from certain that the Sigillariæ and Calamites are most nearly related to the Coniferæ.

III. The *Age of Angiosperms*, or our common trees, like the Oak, Elm, &c., beginning with the Tertiary.

The interval between the second and third of these ages is occupied mainly by Coniferæ, the Pine tribe, and Cycadeæ, the true Gymnosperms, species of which were abundant in the Coal Period, and have continued common ever since. The Coniferæ, in the simplicity of their flowers and their naked seed, are next akin to the Acrogens or flowerless trees. Although in the main a flowerless vegetation, for the few supposed remains of flowers observed abroad have been recently referred to undeveloped leaf-buds, it appears probable from the observations of Dr. Newberry, that there were some true flowers over the Ohio prairies,—apparently monocotyledonous, and related to the Lily tribe. But no traces of Palms or monocotyledonous trees have been found in the coal fields of this country.

Combining the results from the animal and vegetable kingdoms, we should introduce the Age of Acrogens, for the Coal Period and Permian, between the Age of Fishes and Age of

Reptiles,—a space in time zoölogically occupied by the overlapping of these two ages.*

The order then reads, the Age of MOLLUSKS, of FISHES, of ACROGENS or Coal plants, of REPTILES, of MAMMALS, of MAN.

The limits of these ages are as distinct as history admits of; their blendings where they join, and the incipient appearance of a type before the age it afterwards characterizes fully opens, are in accordance with principles already explained.

The reality of progress from lower to higher forms is not more strongly marked in these names, properly applied, than in the rocks. If, hereafter, mammals, reptiles, or fishes, are found a little lower than now known, it will be changing but a sentence in the history,—not the grand idea which pervades it.

A theory lately broached by one whose recent death has caused universal grief to science, supposes that the Reptilian was an age of diminished life, between the two extremes in time, the Palæozoic and Mammalian Ages. But, in fact, two grand divisions of animals, the Molluscan and Reptilian, at this time reach their climax and begin their decline, and this is the earliest instance of the highest culmination of a grand zoölogical type.

Preceding the Silurian or Molluscan Age, there is the AZOIC AGE, or *age without animal life.* It was so named by Murchison and De Verneuil; and was first recognized in its full importance, and formally announced in this country, in the Geological Report of Messrs. Foster and Whitney, although previously admitted in an indefinite way by most Geologists.†

It embraces all the lowest rocks up to the Silurian, for much of the lowest granite cannot be excluded.

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* This Age would perhaps be more correctly styled the *Age of Conifers,* as Conifers, a higher group than Acrogens, were among the earliest of all land plants, occuring in the upper Devonian as well as Carboniferous; and the ages in other cases are named from the superior group of species. Yet as the Acrogens were especially characteristic of the era, and the Conifers have their fullest development in the present age, the name above given seems to be preferable; unless it prove true that the Sigillariæ and Calamites are actually related to the Coniferæ as urged by Brongniart. *Zoologically,* the age has some title to the name, *Age of Amphibians.* But before it closed, true reptiles had appeared. It is a significant fact that the Amphibians in some cases appear to have approached true reptiles, as much as some of the genera of Acrogens the Conifers. An interesting example of this, from the coal formation of Ohio, has recently been mentioned by Dr. J. Wyman, (Tenth Meeting Amer. Assoc. at Albany.)

† Report on the Geology of the Lake Superior Land District, by J. W. Foster and J. D. Whitney, U. S. Geologists; Part II, The Iron Regions, together with General Geology. Senate Executive Document, No. 4, Special Session, March, 1851. Ordered to be printed, March 13, 1851. 406 pp. 8vo, with many plates, and a large geological map and section.

The actual absence of animal life in the so-called Azoic Age in this country is rendered highly probable, as Foster and Whitney show, by the fact that many of the rocks are slates and sandstones, like fossiliferous Silurian rocks, and yet have no fossils; and moreover, the beds on this continent were uplifted and folded, and to a great extent crystallized on a vast scale, before the first Silurian layers were deposited. A grand revolution is here indicated, apparently the closing event of the early physical history of the globe.*

(*To be continued.*)

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* Foster and Whitney observe, (loc. cit. pp. 7, 26, 132,) that at Chippewa Island (in the Menomonee River, near 45½° N., 88° W.,) the Potsdam sandstone lies on the up-turned Azoic slates. At White Rapids, lower down the stream, the same sandstone rests on the tilted edges of the Azoic quartz rock. Near Presqu'Isle (not far from 46° 30′—46° 35′ N, 87° 33′ W.,) a similar contact of the nearly horizontal Potsdam and the vertical quartz rock is seen.

The Azoic of this continent was well studied and defined at a still earlier date by the distinguished geologist of Canada, Sir William E. Logan. In his Annual Report for 1846-1847, and that for 1848, he points out several examples of the Silurian covering the contorted Azoic, and his subsequent surveys have added to the facts of this kind. They occur north of the Lakes Huron and Superior, and along and to the north of the Saint Lawrence. Moreover, in the vicinity of the lakes just mentioned, he found the Azoic divided into two unconformable groups, a *lower*, since called by him the *Laurentian*, and an upper, the *Huronian;* the former consisting of granite, syenite, gneiss, hornblende rock, hypersthene rock, crystalline limestones, &c.; the latter of diorite, slates, white and red sandstones, conglomerates, limestones, the whole much intersected by trap and metalliferous veins containing native copper, &c., and having a thickness in some places, probably of 9,000 to 12,000 feet.

Sections representing the nearly horizontal Lower Silurian overlying the Azoic, as observed by him in the vicinity of the St. Lawrence north-east of Lake Champlain, are figured in the Quarterly Journal of the Geological Society of London, for 1852, pp. 203 and 206.

In the progress of the Geological Survey of New York, commencing in 1836, the fact that the crystalline rocks of Northern New York were older than the Silurian was early shown, but good sections illustrating the superpositions of the two were not given.

At the meeting of the American Association at Cincinnati in 1851, when Foster and Whitney first presented their views on the Azoic, Prof. Mather stated that he had traced the continuation of the system nearly to the sources of the Mississippi and on the waters of the St. Peters,—a region since reported on by Dr. D. D. Owen, (Geol. Survey of Wisconsin, Iowa and Minnesota, 4to, 1852); Dr. H. King contributed observations on the Azoic or iron mountain region of Missouri, (p. 194, Amer. Assoc. Rep. 1851,) indicating the inferiority in position of these rocks to the Silurian, as had been urged by Messrs. Foster and Whitney from the investigations by Mr. Mersch under their direction; and Dr. Engelmann described related rocks in Arkansas between Little Rock and the Hot Springs.

Professors W. B. and H. D. Rogers refer to Azoic Rocks as found in the Appalachians; but no instances of the superposition of the lowest Silurian in those regions on other *non-conformable* beds have yet been published; and it is a question whether the metamorphic rocks are all related to those of New England in age, or partly of this era of metamorphism and partly Azoic.

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ARTICLE LVI.—*On American Geological History*:—Address before the American Association for the Advancement of Science, August, 1855, by JAMES D. DANA.*

(*Concluded.*)

As plants may live in water too hot or impure for animals, and moreover, since all nature exemplifies the principle that the earth's surface was occupied with life as soon as fitted, and with the highest forms the conditions of the time allowed, we may reasonably infer that there may have been in Azoic times marine species and plant-infusoria forms adapted to aid in the earth's physical history; and thus vegetation may have long preceded animal life on the globe.†

* Silliman's American Journal of Science, November, 1856.

† The evidence with respect to the existence of plants in the Azoic Age, though by no means positive, is stronger than here stated.—In the *first* place, there are *limestones* among the folded strata; and as limestones of later ages were almost wholly of organic origin, these of Azoic rocks *may*

After these general remarks on the divisions of Geological time, I now propose to take up the characteristic features and succession of events in American Geology.

In the outset we are struck with the comparative simplicity of the North American continent, both in form and structure. In *outline*, it is a triangle, the simplest of mathematical figures; in *surface*, it is only a vast plain lying between two mountain ranges, one on either border, the Appalachian from Labrador to Alabama on the east, the Rocky Mountains on the west; and on its *contour* it has water, east, west, north and south.

Observe too that its border heights are proportioned to the size of the oceans. A *lofty* chain borders the Pacific, a *low* one the narrow Atlantic, while the small Arctic sea is faced by no proper mountain range.

This principle, that the highest mountains of the continents face the largest oceans, is of wide application, and unlocks many mysteries in physical geography. South America lies between the same oceans as North America: it has its eastern low range, its western Andes; and as the oceans widen southward, the continent is there pinched up almost to a narrow mountain ridge. It differs from North America in having a large expanse of ocean, the Atlantic, on the north; and, correspondingly, it has its northern mountain ridges. The world is full of such illustrations, but I pass them by.

This simplicity of ocean boundary, of surface features, and of outline, accounts for the simplicity of geological structure in North America. We may make indeed the wider statement, that all these qualities are some way connected with the positions and extent of the oceans, they seeming to point to the conclusion, that the subsidence of the oceanic basins had determined the continental features; and that farther, both results were involved in the earth's gradual refrigeration, and consequent contraction.

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also have been so.—2nd, *Graphite* is a common mineral in some of the crystalline rocks, and graphite is known to result from the alteration by heat of the carbon of plants.—3rd, the Huronian rocks, according to Sir W. E. Logan, actually contain some small seams of anthracite.—4th, Vegetation, as it is directly or indirectly the food of animals, should necessarily have preceded animal life.—With reference to the statement in the text above, it should be noted that vegetation has been observed growing among the Geysers of Iceland, in waters having a temperature of 180° F.; and the writer has seen a case of similar kind, on Luzon, one of the Philippines, where the temperature was 160° F. This is much beyond the limit, which the eggs of animals can endure and survive.

America has thus the simplicity of a single evolved result. Europe, on the contrary, is a world of complexities. It is but one corner of the Oriental continent,—which includes Europe, Asia, and Africa,—and while the ocean bounds it on the north and and west, continental lands inclose it on the south and east. It has ever been full of cross purposes. American strata often stretch from the Atlantic west beyond the Mississippi; and east of the Rocky Mountains, it has but one proper mountain range of later date than the Silurian. Europe is much broken up into basins, and has mountains of all ages: even the Alps and Pyrenees are as recent as the Tertiary.

This wide contrast accounts for the greater completeness or generality of American revolutions, the more abrupt limits of periods, and clearer exhibition of many geological principles.

The geological structure of this country has been made known through the combined researches of a large number of investigators. The names of MACLURE, SILLIMAN, EATON, lead off the roll; HITCHCOCK, the Professors ROGERS, the well-known GEOLOGISTS of the NEW YORK SURVEY, also, OWEN, PERCIVAL, MORTON, CONRAD, TUOMEY, and many others, have made large contributions to the accumulating results. Yet the *system* may be said to have been mainly laid open by four sets of observers, —MORTON for the Cretaceous; CONRAD for the Tertiary; the NEW YORK GEOLOGISTS for the Palæozoic strata; and the Professors ROGERS for the Carboniferous beds and the Appalachians.

The succession of Silurian and Devonian rocks in the State of New York is the most complete in the country, and it was well for the science that its rocks were so early studied, and with such exactness of detail. The final display of the Palæontology by Mr. James Hall has given great precision to the facts, and the system has thereby become a standard of comparison for the whole country, and even for the world.

This accomplished, the Carboniferous rocks were still to be registered, and the grand problem of New England Geology solved. The Professors Rogers, in the surveys of Pennsylvania and Virginia, followed out the succession of strata from the Devonian through the Coal Period, and thus, in a general way, completed the series. And more than this, they unravelled with consummate skill the contortions among the Appalachians, bringing order out of confusion, and elucidating a principle of mountain-making which is almost universal in its application. They showed that the Silurian, Devonian, and Carboniferous strata, which were originally laid out in horizontal layers, were afterwards pressed on to the north-westward, and folded up till the folds were of mountain height, and that thus the Appalachians had their origin; and that also, by the escaping heat of those times of revolution, extensive strata were altered, or even crystallized.*

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* As I have already remarked, many names are above omitted which have contributed largely to our knowledge of American Geology.

While Dr. MORTON was the first to distinguish the North American *Cretaceous* beds, and pursued his researches with great energy and skill, they have been largely studied also by LYELL in different localities on the east and south, by NICOLLET and recently SHUMARD, HAYDEN, MEEK and HALL, on the beds west of the Mississippi, by ROEMER in Texas, TUOMEY in South Carolina, H. D. ROGERS and others in New Jersey, J. W. BAILEY with reference to microscopic species, and J. LEIDY for Vertebrate Remains.

The *Tertiary* has been investigated by LYELL along both the eastern and southern border; also in different localities by MORTON, M. TUOMEY, F. S. HOLMES, C. S. HALE, I. LEA, H. D. and W. B. ROGERS, ROEMER, J. D. DANA and W. P. BLAKE for the tertiary of the Pacific coast, BAILEY for minute species, HARLAN, OWEN, MULLER, PROUT, LEIDY, WYMAN and GIBBES, for Vertebrate fossils; while these and many other authors have published on the *post-tertiary* deposits and organic remains.

The *Silurian* and *Devonian* systems have occupied the attention of nearly all who have written on American Geology, in the East or West, among whom, there are:—HALL, MATHER, VANUXEM, EMMONS, CONRAD, DE VERNEUIL of Paris, the Professors ROGERS Messrs. WHITNEY and FOSTER, D. D. OWEN, C. T. JACKSON, D. HOUGHTON of Michigan, G. TROOST and lately J. M. SAFFORD of Tennessee, J. GREENE, J. LOCKE, C. WHITTLESEY, I. A. LAPHAM, G. C. SWALLOW, J. G. NORWOOD, B. F. SHUMARD, besides the investigators in Canada, Sir W. E. LOGAN, J. BIGSBY, J. W. DAWSON, T. S. HUNT and others.

The *Carboniferous* formation was early studied in many of its details by Dr. S. P. HILDRETH. But the successive strata of the whole formation from the Devonian through the Subcarboniferous and Coal Measures, were first systematized by the Professors ROGERS, though without yet marking out in any of their publications the subdivisions of the coal measures themselves and the characteristic fossils of each, as had been done for the Devonian and Silurian by the New York Geologists. Other researches on the coal beds have been made by R. C. TAYLOR and J. P. LESLIE in Pennsylvania, J. HALL, D. D. OWEN, and others in the states of the Mississippi valley, J. S. NEWBERRY on the fossil plants and fishes of the Ohio coal measures, HITCHCOCK and C. T. JACKSON on the coal beds of Rhode Island; DAWSON, LYELL, JACKSON, &c., on the new Brunswick and Nova Scotia beds; LEA, WYMAN, LEIDY, LYELL and DAWSON on Reptillian and other carboniferous fossils.

This key soon opened to us a knowledge of New England geology, mainly through the labors of Prof. Hall, and also of Professor H. D. Rogers, following up the survey of President Hitchcock; and now the so-called primary rocks, granite, gneiss, schists, and crystalline limestones, once regarded as the oldest crystallizations of a cooling globe, are confidently set down as for the most part no older than the Silurian, Devonian, and Carboniferous of New York and Pennsylvania.*

Let us now briefly review the succession of epochs in American geological history.

The Azoic Age ended, as was observed, in a period of extensive metamorphic action and disturbance,—in other words, in a vast revolution. At its close, some parts of the continent were left as dry land, which appear to have remained so, as a general thing, in after times; for no subsequent strata cover them. Such are a region in Northern New York, others about and beyond Lake Superior, and a large territory stretching from Labrador westward,

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The parallelism of the rock formations of the east and west has been determined mainly through the researches of Prof. Hall, who first presented his views on the subject in 1841, and continues still his investigations. The examinations of De Verneuil; besides defining the limits of our Devonian, also contributed much on this subject.

The red sandstone and trap regions of the Triassic or Jurassic period, which occur in the Connecticut valley and in other valleys parallel with the Atlantic border to the south, and also to the north beyond Nova Scotia, have been specially investigated by D. Olmsted, E. Hitchcock, J. G. Percival, Professors Rogers, E. Emmons, J. W. Dawson, C. T. Jackson, F. Alger; and as regards the vertebrate fossils, by E. Hitchcock, J. Deane, W. C. Redfield, J. H. Redfield, J. Wyman, J. Leidy, I. Lea, and Prof. Owen of London; and the plants, by the Professors Rogers, C. T. F. Bunbury, and E. Hitchcock, Jr.

* The labors of Sir W. E. Logan have thrown great light upon New England geology, and are giving a definiteness to our knowledge hitherto unattained. He is finding that some of the crystalline New England rocks which stretch north into Canada, are there uncrystalline and fossiliferous, and thus is putting the question of age beyond doubt. The Berkshire limestone has thus been determined at its northern extremity as well as in New Jersey; the calcareous mica slate of western Vermont, has been shown to be Upper Silurian in age, it being uncrystalline limestone towards Gaspé, partially metamorphic and still containing distinct traces of fossils in the valleys of the river St. François and Lake Memphremagog, and farther south becoming more crystalline as well as calcareous and losing all indications of fossils. Prof. T. S. Hunt of the Canada Survey, has brought other facts to bear on this subject.

as recognized by Messrs. Foster and Whitney and Prof. Hall, and the geologists of Canada.*

The Silurian or Molluscan Age next opens. The lowest rock is a sandstone, one of the most widely spread rocks of the continent, stretching from New England and Canada south and west, and reaching beyond the Mississippi,—how far is not known. And this first leaf in the record of life is like a title page to the whole volume, long afterwards completed; for the nature of the history is here declared in a few comprehensive enunciations.

1. The rock, from its thin, even layers, and very great extent, shows the wide action of the ocean in distributing and working over the sands of which it was made; and the ocean ever afterward was the most active agency in rock-making.

2. Moreover, ripple marks, such as are made on our present seashores or in shallow waters, abound in the rock, both through the east and west, and there are other evidences also of moderate depths, and of emerged land.† They all announce the wonderful fact, that even then, in that early day, when life first began to light up the globe, the continent had its existence,—not in embryo, but of full-grown extent; and the whole future record is but a working upon

* The Azoic lands, above the ocean at this time, recognized by Messrs. Foster and Whitney in the Report referred to, were that of the Azoic region, between Lake Superior and Hudson's Bay, that between Lake Superior and Lake Michigan, the Azoic Island of Northern New York; and the facts they state would add the Missouri iron-mountain region, and the metamorphic region of Arkansas as possibly other islands. Mr. Whitney has more recently shown that the occurrence of great masses of specular or magnetic iron is proof that the metamorphic rocks containing them are of the Azoic age or præ-Silurian.

On the Geological map of northern North America, published by Mr. Isbister in the Quarterly Journal of the Geological Society for 1855, xi, 497, the Azoic is shown to extend in a narrow band northwestward from Canada to the Arctic sea between Hudson's Bay and the Winnipeg line of small lakes.

† Other marks of shallow water alluded to are wave lines, and the oblique lamination characterising many subordinate layers in the rock,—the latter due to changing currents, like the ebb and flow of tides, or variations in tidal or other currents, or the occasional actions of storm waves. This oblique lamination as well as ripple marks, occurs abundantly in the Potsdam sandstone of northern New York (Emmons' Geol. Rep., p. 104, 130); in Canada (Logan's Reports, 1851–52, p. 12 and elsewhere); south of Lake Superior (Foster and Whitney, loc. cit. p. 118); in the Upper Mississippi (Owen, Survey of Wisconsin, &c., p. 48); in Pennsylvania and Virginia (Professors H. D. and W. B. Rogers).

the same basis, and essentially within the same limits. It is true that but little of it was above the sea, but equally true that little of it was at great depths in the ocean.

3. Again, in the remains of life which appear in the earliest layers of this primal rock, three of the four great branches of the Animal Kingdom are represented,—Mollusks, Trilobites among Articulates, and Corals and Crinoids among Radiates,—a sufficient representation of life for a title-page. The New York beds of this rock had afforded only a few mollusks; but the investigations of Owen and others have added the remaining tribes; and this diversity of forms is confirmed by Barrande in his Bohemian researches.*

Among the genera, while the most of them were ancient forms that afterwards became extinct, and through succeeding ages thousands of other genera appeared and disappeared; the very earliest and most universal was one that now exists,—the genus *Lingula*, —thus connecting the extremes of time, and declaring most impressively the unity of creation. Mr. T. S. Hunt, of the Canada Geological Survey, recently discovered that the ancient shell had the anomalous chemical constitution of bones, being mainly phos-

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* The *Lingula prima* and *L. antiqua* are the Mollusks referred to as occurring in the New York beds. The discoveries by Owen, in the vicinity of the Falls of the St. Croix, Minnesota, and on the Mississippi, were published by him in his Report on a *Geological Reconnaissance of the Chippewa Land District of Wisconsin and the Northern part of Iowa*, Washington (Senate Document), 1848, p. 14, and subsequently in his quarto Report on Wisconsin, &c., of 1852. The fossils he mentions in the latter work are species of *Lingula, Obolus, Orbicula, Orthis*, several forms of Crinoids, and large Trilobites referred mostly to the new genus *Dikelocephalus*. The species as named are, *Lingula antiqua, L. prima, L. pinnaformis* Owen, L. *ampla* Owen, *Obolus Apollinis* (?), *Orbicula prima* O., *Dikelocephalus Minnesotensis* O., *D. Miniscaencis* O., *D.* (?) *Iowensis* O., *D. granulosus* O., *D. Pepinensis* O., *Lonchacephalus Chippewaensis* O., *Crepicephalus* (?) *Wisconsensis* O., *C. Miniscaensis* O.

Prof. W. B. Rogers in the last number of this Journal (p. 296), announced the discovery of the Trilobite *Paradoxides Harlani* of Green (*P. spinosus* of Barrande) in slates ten miles south of Boston, Mass., a species found by Barrande in his protozoic or earliest fossiliferous rock of Bohemia,—thus adding a new species to the American protozoic Fauna, and the largest yet discovered, the length of some of the specimens exceeding a foot. Prof. E. Emmons announces also (Meeting of Amer. Assoc. in August last, at Albany) the discovery of a large Cyathophylloid coral in the lowest fossiliferous rocks of North Carolina. The exact age of the rock however is yet uncertain.—See a notice beyond in this number.

phate of lime; and afterwards he found in a modern Lingula the very same composition,—a further announcement of the harmony between the earliest and latest events in geological history.*

This earliest sandstone,—called in New York the Potsdam sandstone,—and the associated Calciferous sand-rock, mark off the *First Period* of the Molluscan Age,—the POTSDAM PERIOD, as it may be called.†

Next followed the TRENTON PERIOD,—a period of limestones, (the Trenton limestone among them,) equal to the earlier beds in geographical limits, and far more abundant in life, for some beds are literally shells and corals packed down in bulk; yet the species were new to the period, the former life having passed away; and even before the Trenton Period closed, there were three or four epochs of destruction of life followed by new creations. The formation of these limestone beds indicates an increase in the depth of the continental seas,—an instance of the oscillation of level to which the earth's crust was almost unceasingly subject through all geological ages until the present.

After the Trenton Period, another change came over the continent, and clayey rocks or shales were formed in thick deposits in New York, and south,—the Utica slate and Hudson River shales, —while limestones were continued in the West. This is the HUDSON PERIOD; and with it, the *Lower Silurian* closed.‡

The seas were then swept of their life again, and an abrupt transition took place both in species and rocks. A conglomerate covered a large part of New York and the States south, its coarse

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* Am. Jour. Sci., [2], xvii, 235, (1854).

† Through the comparisons of Prof. Hall, it is now well known that the "Lower Magnesian Limestone" of the west, and a sandstone with which it alternates, correspond to the Calciferous sandrock of New York.

‡ Prof. Hall, in connection with J. D. Whitney, has recently made the important observation, that the Galena or lead-bearing limestone, which is the upper member of the Trenton group, is separated from the Niagara limestone in Iowa and Wisconsin by thick strata of Hudson River shales, giving a prolongation to these shales before unsuspected. He had previously, with Mr. Whitney, traced these shales around the north side of Lake Huron and Lake Michigan to Pointe aux Baies, and thence along Green Bay to Lake Winnebago. These shales are however partly replaced by limestone in Ohio, &c.

material evidence of an epoch of violence and catastrophe: and with this deposit the *Upper Silurian* began.

The Upper Silurian has also its three great periods,—the NIAGARA, the ONONDAGA, and the LOWER HELDERBERG, besides many subordinate epochs,—each characterized by its peculiar organic remains,—each evidence of the nearly or quite universal devastation that preceded it, and of the act of omnipotence that reinstated life on the globe,—each, too, bearing evidence of shallow or only moderately deep waters when they were formed; and the Onondaga Period,—the period of the New York salt rocks—telling of a half-emerged continent of considerable extent.

Another devastation took place, and then opened, as De Verneuil has shown, the Devonian Age or Age of Fishes. It commenced, like the Upper Silurian, with coarse sandstones, evidence of a time of violence; these were followed by another grit rock, whose few organic remains show that life had already reappeared. Then another change,—a change evidently in depth of water,—and limestones were forming over the continent, from the Hudson far westward: the whole surface became an exuberant coral reef, far exceeding in extent, if not in brilliancy, any modern coral sea; for such was a portion, at least, of the UPPER HELDERBERG Period.

Again there was a general devastation, leaving not a trace of the former life in the wide seas; and where were coral reefs, especially in the more eastern portion of the continental seas, sandstones and shales accumulated for thousands of feet in thickness, with rarely a thin layer of limestone. Thus passed the HAMILTON, CHEMUNG and CATSKILL Periods, of the Devonian age. The life of these regions, which in some epochs was exceedingly profuse, was three or four times destroyed and renewed—not renewed by a re-creation of the same species, but by others; and although mostly like the earlier in genera, yet each having characteristic marks of the period to which it belonged. And while these Devonian Periods were passing, the first land plants appeared, foretellers of the age of verdure, next to follow.

Then come vast beds of conglomerate, a natural opening of a new chapter in the record, and here it is convenient to place the beginning of the Carboniferous Age, or the Age of Acrogens. Sandstones and shales succeeded, reaching a thickness in Pennsylvania and New Jersey, according to the Professors Rogers, of thousands of feet; while in the basin of the Ohio and Mississippi, in the course of this era, the Subcarboniferous limestone was forming from immense Crinoidal plantations in the seas.*

Another extermination took place of all the beautiful life of the waters, and a conglomerate or sandstone was spread over the encrinital bed: and this introduced the true coal period of the Carboniferous Age;—for it ended in leaving the continent, which had been in long-continued oscillations, quite emerged. Over the regions where encrinites were blooming, stretch out vast wet prairies or marshes of the luxuriant coal vegetation. The old system of oscillations of the surface still continues, and many times the continent sinks to rise again,—in the sinking, extinguishing all continental life, and exposing the surface to new depositions of sandstone, clays, or limestone, over the accumulated vegetable remains; in the rise, depopulating the seas by drying them up, and preparing the soil for verdure again; or at times, convulsive movements of the crust carrying the seas over the land, leaving destruction behind. And thus, by repeated alternations, the coal period passes, some six thousand feet of rock and coal-beds being formed in Pennsylvania, and fourteen thousand feet in Nova Scotia.

I have passed on in rapid review, in order to draw attention to the series or succession of changes, instead of details.† So brief an outline may lead a mind not familiar with the subject to regard the elapsed time as short; whereas to one who follows out the various alternations and the whole order of events, the idea of *time immeasurable* becomes almost oppressive.

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* This Subcarboniferous limestone is sparingly represented in Pennsylvania among the sandstones and shales; but according to Prof. W. B. Rogers it increases to the southward, and in Virginia acquires a thickness of 1500 to 2000 feet.

† The names given to the subdivisions of the Palæozoic rocks are the same that have been laid down by the New York Geologists, whose assiduous and successful labors in a territory of so great geological importance, entitle them to pronounce upon the nomenclature of American Rocks. I have varied from the ordinary use of the terms only in applying them to the periods and epochs when the rocks were formed, so as to recognize thereby the historical bearing of geological facts. The Periods and Epochs thus made out are as follows—excluding minor subdivisions which may make Sub-epochs, and not attempting to give the parallel subdivisions for the West. On this subject, the volumes and papers by Prof. Hall especially should be consulted.

I.—SILURIAN AGE.

1. *Lower Silurian.*

1. Potsdam Period.—1st Epoch. Potsdam sandstone: 2nd. Calciferous sandrock.

2. Trenton Period.—1st Epoch. Chazy limestone; 2nd. Birdseye; 3rd. Black River; 4th. Trenton.

3. Hudson Period.—1st. Epoch. Utica Shale; 2nd. Hudson River Shale. (Hudson River Shale and Blue limestone of Ohio in parts of the west.)

2. *Upper Silurian.*

1. Niagara Period.—1st. Epoch. Oneida Conglomerate; 2nd. Medina Sandstone; 3rd. Clinton Group; 4th. Niagara Group.

2. Onondaga Period.—1st. Epoch. Galt limestone; 2nd. Onondaga Salt Group.

3. Lower Helderberg Period.—Limestones. (Statement of epochs here omitted.)

II. DEVONIAN AGE.

1. Oriskany Period.—1st Epoch. Oriskany Sandstone; 2nd. Canda-galli Grit.

2. Upper Helderberg Period.—1st Epoch. Schoharie Grit; 2nd. Upper Helderberg group.

3. Hamilton Period.—1st Epoch. Marcellus Shales; 2nd. Hamilton group; 3rd. Genesee Slate.

4. Chemung Period.—1st Epoch. Portage; 2nd. Chemung group.

5. Catskill Period.—Catskill Red Sandstones and Shales. (No. IX. of Rogers.)

III. CARBONIFEROUS AGE.

1. Subcarboniferous Period.—1st Epoch. Conglomerates, Sandstones and Shales (with some coal seams;) 2nd. Sandstones, Shales and Carboniferous limestone. Nos. X. and XI. of Rogers.

2. Carboniferous Period.—1st Epoch. Millstone Grit; 2nd. Lower Coal Measures; 3rd. Upper Coal Measures. Nos. XII. and XIII. of Rogers.

3. Permian Period.—Probably unrepresented in Eastern North America, except by the events of the Appalachian Revolution.

Before continuing the review, I will mention some conclusions which are here suggested.

I. In the first place, through the periods of the Silurian and Devonian, at twelve distinct epochs at least, the seas over this American continent were swept of all or nearly all existing life, and as many times they were repeopled: and this is independent of many partial exterminations and renewals of life that at other times occurred.

If Omnipotent Power had been limited to making *monads* for after development into higher forms, many a time would the whole process have been utterly frustrated by hot water, or by mere changes of level in the earth's crust, and creation would have been at the mercy of dead forces. The surface would have required again and again the sowing of monads, and there would have been a total failure of crops after all; for these exterminations continue to occur through all geological time into the Mammalian Age.

II. Again: I have observed that the continent of North America has never been the deep ocean's bed, but a region of comparatively shallow seas, and at times emerging land; and was marked out in its great outlines even in the earliest Silurian. The same view is urged by De Verneuil, and appears now to be the prevailing opinion among American geologists. The depth at times may have been measured by the thousand feet, but not by miles.

III. During the first half of the lower Silurian era, the whole east and west were alike in being covered with the sea. In the first on Potsdam Period, the continent was just beneath or at the surface. In the next or Trenton Period, the depth was greater, giving purer waters for abundant marine life. Afterwards, the east and west were in general widely diverse in their formations; limestones, as Mr. Hall and the Professors Rogers have remarked, were generally in progress over the west, that is, the region, now the great Mississippi Valley, beyond the Appalachians, while sandstones and shales were as generally forming from northeastern New York south and southwest through Virginia. The former therefore, has been regarded as an area of deeper waters, the latter as, in general, shallow, when not actually emerged. In fact, the region towards the Atlantic border, afterwards raised into the Appalachians, was already, even before the Lower Silurian era closed, the higher part of the land: it lay as a great reef or sand-bank, partly hemming in a vast continental lagoon, where corals, encrinites and mollusks grew in profusion, thus separating more or less perfectly the already existing Atlantic from the interior waters.

IV. The oscillations or changes of level over the continent, through the Upper Silurian and Devonian, had some reference to this border region of the continent: the formations approach or recede from it, and sometimes pass it, according to the limits of the oscillations eastward or westward. Along the course of the border itself there were deep subsidences in slow progress, as it shown by the thickness of the beds. It would require much detail to illustrate these points, and I leave them with this bare mention.

The Hudson River and Champlain valleys appear to have had their incipient origin at the epoch that closed the Lower Silurian; for while the preceding formations cross this region and continue over New England, the rocks of the Niagara and Onondaga Periods (the first two of the Upper Silurian) thin out in New York before reaching the Hudson River. Mr. Logan has recognized the division of America to the northeast into two basins by an anticlinal axis along Lake Champlain, and observes also that the disturbances began as early, at least, as the close of the Lower Silurian, mentioning, too, that there is actually a want of conformity at Gaspé between the beds of the Upper and Lower Silurian,—another proof of the violence that closed the Lower Silurian era.*

But let us pass onward in our geological record.

All the various oscillations that were in slow movement through the Silurian, Devonian, and Carboniferous Ages, and which were increasing their frequency throughout the last, rais-

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* This Eastern border of the American continent, then in process of formation over the present Appalachian region from Labrador and Canada southwestward, lay deeper to the south than to the north. In Canada and the Azoic of Northern New York, there was land out of water, forming its northern limit. From thence it stretched on with its gradually deepening waters, though varying constantly with the oscillations. The thickness of many of the sedimentary beds passing southward from the New York Azoic prove this increasing depth to have been a general fact; and it is corroborated by a statement made by Professor W. B. Rogers (meeting of American Association in August last at Albany,) that the subcarboniferous sandstones and shales containing but little limestone in Pennsylvania, were replaced by beds of the subcarboniferous limestone which to the south in Virginia reach a great thickness (see note to page 317)—the limestones indicating clearer and somewhat deeper waters. The early disturbances and uplifts *in the northeast* near Gaspé and along the Hudson valley also accord with this view.

Again, the position of the Azoic dry land in Canada and of the sedimentary rocks south and southwest, shows us that the Continent in those early times received the northern Labrador current,—which would have kept by the shore as now, along the eastern border of this Azoic,—over New Brunswick and Nova Scotia, and that thence its natural course would have been southwest over the Appalachian region, where the sandstones and shales were extensively accumulated; and therefore its aid in making these deposits can scarcely be doubted.

ing and dipping the land in many alternations, were premonitions of the great period of revolution,—so well elucidated, as already observed, by the Professors Rogers,—when the Atlantic border, from Labrador to Alabama, long in preparation, was at last folded up into mountains, and the Silurian, Devonian, and Carboniferous rocks were baked or crystallized. No such event had happened since the revolution closing the Azoic Period. From that time on, all the various beds of succeeding ages up to the top of the Carboniferous had been laid down in horizontal or nearly horizontal layers, over New England as well as in the west,—for the continent from New England westward, we have reason to believe, was then nearly a plain, either above or below the water; there had been no disturbances except some minor uplifts: the deposits, with small exceptions, were a single unbroken record, untill this Appalachian revolution.*

This epoch, although a time of vast disturbances, is more correctly contemplated as an epoch of the slow measured movement of an agency of inconceivable power, pressing forward from the ocean towards the northwest; for the rocks were folded up without the chaotic destruction that sudden violence would have been likely to produce. Its greatest force and its earliest beginning was to the northeast. I have alluded to the disturbance between the Upper and Lower Silurian beds of Gaspé, to the north. Another epoch of disturbance, still more marked, preceded, according to Mr. Logan, the Carboniferous beds in those northeastern regions; and New England, while a witness to the profound character and thoroughness of the Appalachian revolution, attests also to the greater disturbance towards its northern limits. Some of the Carboniferous strata were laid down in Rhode Island as clay and sand and layers of vegetable debris: they came forth from the Appalachian fires as we now have them, the beds contorted, the coal layers a hard siliceous anthracite or even graphite in places, the argillaceous sands and clays crystallized as talcose schist, or perhaps gneiss or syenite.

These very coal-beds, so involved in the crystalline rocks, are part of the proof that the crystallization of New England took place after the Coal Era. Fossils in Maine, Vermont, Canada,

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* It is urged by Prof. Hall and others that the carboniferous beds in the west lie unconformably on the beds below. But the disturbance indicated was not one of bold flexures or uplifts.

and Massachusetts add to the evidence. The quiet required by the continent for the regular succession and undisturbed condition of the rocks of the Silurian, Devonian, and Carboniferous formations, shows that in neither of these ages could such vast results of metamorphic action and upheaval have taken place.

The length of time occupied by this revolution is beyond estimate. Every vestige of the ancient Carboniferous life of the continent disappeared before it. In Europe, a Permian Period passed, with its varied life; yet America, if we may trust negative evidence, still remained desolate. The Triassic Period next had its profusion of living beings in Europe, and over two thousand feet of rock; America through all, or till its latter portions, was still a blank: not till near the beginning of the Jurassic Period do we find any traces of new life, or even of another rock above the Carboniferous.

What better evidence could we have than the history of the oscillations of the surface from the earliest Silurian to the close of the Carboniferous Age, and the final cresting of the series in this Appalachian revolution, that the great features of the continent had been marked out from the earliest time? Even in the Azoic, the same northeast and southwest trend may be observed in northern New York and beyond Lake Superior, showing that, although the course of the great Azoic lands was partly east and west, the same system of dynamics that characterized succeeding ages was then to some extent apparent.

The first event in the records after the Appalachian revolution, was the gathering up of the sands and rolled fragments of the crystallized rocks and schists along the Atlantic border into beds; not over the whole surface, but in certain valleys, which lie parallel with the Appalachian chain, and which were evidently a result of the foldings of that revolution. The beds are the red sandstones and shales, which stretch on for one hundred and twenty miles in the Connecticut valley: and similar strata occur in southeastern New York, in New Jersey, Viginia, North Carolina and Nova Scotia. These long valleys are believed to have been estuaries, or else river courses.

The period of these deposits is regarded as the earlier Jurassic by Professor W. B. Rogers. Dr. Hitchcock supposes a portion of the preceding or Triassic Period to be represented.*

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* This Red Sandstone, after being known for a while under the name of "Old Red Sandstone," was long called the "New Red Sandstone," it being

Many of the layers show, by their shrinkage cracks, ripple-marks, and footprints, as others have observed, that they were formed in shallow waters, or existed as exposed mud-flats. But they accumulated till they were over a thousand feet thick in Virginia, and in New England two or three thousand, according to the lowest estimate. Hence the land must have been sinking to a depth equal to this thickness, as the accumulation went on, since the layers were formed successively at or near the surface.

Is it not plain, then, that the oscillations, so active in the Appalachian revolution and actually constituting it, had not altogether ceased their movements, although the times were so quiet that numerous birds and reptiles were tenants of the Connecticut region? Is it not clear that these old valleys, occurring at intervals from Nova Scotia to South Carolina, originally made by foldings of the earth's crust, were still sinking?

And did not the tension below of the bending rocks finally cause ruptures? Even so: and the molten rock of the earth's interior which then escaped, through the crystalline rocks beneath and the overlying sandstone, constitutes the trap mountains, ridges, and dykes, thickly studding the Connecticut Valley,

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shown to be above the carboniferous system. The first step towards a nearer determination of its age was made by Mr. J. H. Redfield in a paper on the Fossil Fishes of the Connecticut valley published in 1836, who made it Jurassic (Lias or Oolitic,) (Ann. Lyc. N. Hist. N. Y., vol. iv.) Mr. W. C. Redfield added to the facts bearing on this conclusion through discoveries made in New Jersey and Virginia. Prof. W. B. Rogers deduced from the coal plants of the Richmond beds, the same age for those beds, while admitting that other beds of the sandstone might be Triassic. Afterwards on finding the same Posidonia and Cypridæ in North Carolina, in each of the beds in Virginia, in the belt in Pennsylvania near Phenixville, and one plant (Lycopodites Williamsonis) common to Virginia and Massachusetts, he suggested that all the beds were probably Jurassic (Am. J. Sci. [2,] xix, 123.) Mr. E. Hichcock, Jr., detected recently a fossil plant (*Clathropteris rectiusculus*, Am. J. Sci. [2,] xx, 22,) near the middle of the sandstone formation in Massachusetts, and remarks that it indicates the existence of the Lower Jurassic at that place, and also renders it probable that the Triassic may be represented in the inferior beds, as is sustained by Prof. Hitchcock. Prof. Emmons has recently obtained Reptilian Fish, and Molluscan fossils in North Carolina, (communicated to the Amer. Assoc. at Albany in August last,) which are related to those of the Triassic and Jurassic periods. The amount of evidence as far as now understood therefore tends to sustain the view that the Period of the sandstone, while it may cover part of the Triassic, is mainly Jurassic.

standing in palisades along the Hudson, and diversifying the features of New Jersey and parts of Virginia and North Carolina. The trap is a singularly constant attendant on the sandstone, and everywhere bears evidence of having been thrown out soon after the deposition of the sandstone, or in connection with the formation of its later beds. Even the small sandstone region of Southbury in Connecticut, has its trap.

Thus ended in fire and violence, and probably in submergence beneath the sea, the quiet plains of the Connecticut valley, where lived, as we now believe, the first birds of creation; kinds that were nameless, until, some countless ages afterwards, President Hitchcock tracked them out, found evidence that they were no unworthy representatives of the feathered tribe, and gave them and their reptile associates befitting appelations.*

Such vast regions of eruptions could not have been without effusions of hot water and steam, and copious hot springs. And may not these heated waters and vapors, rising through the crystalline rocks below, have brought up the copper ores, that are now distributed, in some places, through the sandstone? The same cause, too, may have given the prevalent red color to the rock, and produced changes in the adjoining granite.

After the era of these rocks, there is no other American record during the European Jurassic Period.

In the next or Cretaceous Period, the seas once more abound in animal life. The position of the cretaceous beds around the Atlantic borders shows that the continent then stood above the sea very much as now, except at a lower level. The Mississippi valley, which, from the Silurian, had generally been the region of deeper waters, was even in cretaceous times occupied to a considerable extent by the sea,—the Mexican Gulf then reaching far north, even high up the Missouri, and covering also a considerable part of Texas and the Rocky Mountain slope.

An age later, the Cretaceous species had disappeared, and the Mammalian Age (or the Tertiary, its first Period) begins, with a wholly new Fauna, excepting, according to Professor Tuomey, some half a dozen species, about which however there is much doubt. The continent was not more elevated than in the preced-

* Mr. J. Deane of Greenfield was also an early explorer of these tracks, and is now engaged in publishing on the subject, illustrating his memoirs with plates of great beauty and perfection.

ing age, and the salt waters of the Mexican Gulf were withdrawn from the region of Iowa and Wisconsin, so as not to reach beyond the limits of Tennessee.*

Two or three times in the course of the Tertiary Period, the life of the seas was exterminated, so that the fossils of the later Tertiary are not identical with any in the earliest beds,—excluding some fish remains, species not confined to the coast waters. The crust of the earth was still oscillating; for the close of the first Tertiary epoch was a time of subsidence; but the oscillation or change of level was slight, and by the end of the Tertiary, the continent on the east stood within a few feet of its present elevation, while the Gulf of Mexico was reduced nearly to its present limits.†

I have thus brought this rapid sketch to the close of the Tertiary, having omitted much of great interest, in order to direct attention to the one grand fact,—that the continent from the Potsdam sandstone, or before, to the Upper Tertiary, was one in its progress,—a single consecutive series of events according to a common law. It is seen, that the great system of oscillations, due to force pressing or acting from the southeast, which reached its climax in the rise of the Appalachians, then commenced a decline. We mark the oscillations still producing great results

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* The recent investigations of F. B. Meek and Dr. J. V. Hayden, have shown (Proc. Acad. Nat. Sci. Philad., viii, 111, 1856,) that while there is much *fresh-water* tertiary in the Nebraska regions and beyond, there is also about the head waters of the Missouri some *marine* tertiary. The region investigated lies between the 46th and 49th parallels of North latitude and the 100th and 108th degrees of longitude: but it is not yet ascertained whether the body of salt water thus indicated was an isolated area, or an arm from the Mexican Gulf. The shells, (species of Ostrea, Corbula, and Cerithium) do not satisfactorily fix the age of the tertiary, but suggest, the authors say, that it may be the older Eocene. They occur in the same beds with numerous freshwater shells, species of Melania, Physa, Paludina, Cyrena, and all are such kinds as inhabit fresh and brackish waters. The tertiary deposits of the Bad Lands, or that part where the bones occur, have afforded no evidence of salt water origin; and the same is true of the Lignite beds of the far north. While therefore the tertiary beds are extensive, the marine tertiary, indicating the presence of the sea, as far as present knowledge goes, is quite limited.

† Naming the North American Tertiary Epochs from prominent localities as in the Palæozoic, they are :—1. The Claiborne, or Older Eocene; 2. The Vicksburg, or Newer Eocene; 3. The Yorktown, or Pliocene and Miocene in one.

in the Jurassic Period along the whole eastern border from Nova Scotia to the Carolinas. Less effect appears in the Cretaceous Period; and gradually they almost die out as the Tertiary closes, leaving the Mississippi Valley and the eastern shores near their present level.

Thus were the great features of Middle and Eastern North America evolved; nearly all its grand physical events, including its devastations and the alternations in its rocks, were consequent upon this system of development. Moreover, as I have observed, this system was some way connected with the relative position of the continent and the oceanic basin.

We need yet more definite knowledge of the Pacific border of North America to complete this subject. It is in accordance with the fact that the highest mountains are there, that volcanoes have been there in action; and also that, in the Tertiary Period, elevations of one to two thousand feet took place; and that immediately before the Tertiary, a still greater elevation of the Rocky Mountains across from east to west occurred. The system of changes between the Rocky Mountains and the Pacific has been on a grander scale than on the Atlantic border, and also from a different direction,—and this last is an element for whose influence on the general features we cannot yet make full allowance.

Through all this time, central British America appears to have taken little part in the operations; and what changes there were, except it may be, in the Arctic regions, conformed to the system prevailing farther south, for the rocks of the Jurassic Age, like the Connecticut River sandstone, are found as far north as Prince Edward's Island, in the Gulf of St. Lawrence.

But the Tertiary Period does not close the history of the continent. There is another long Period the Post-tertiary,—the period of the Drift, of the Mastodon and Elephant, of the lake and river terraces, of the marine beds on Lake Champlain and the St. Lawrence,—all anterior to the Human Era.

From this time there is a fundamental change in the course of operations. The oscillations are from the north, and no longer from the southeast.

The *drift* is the first great event, as it underlies the other loose material of the surface; and all recognize it as a *northern* phenomenon, connected with northern oscillations.

The upper terrace of the lakes and rivers, and also the marine beds four hundred feet above the level of Lake Champlain, and five hundred above the St. Lawrence, which have been called Laurentian deposits, are marks of a *northern* depression, as no one denies.

The subsequent elevation to the present level again, by stages marked in the lower river terraces, was also *northern*, affecting the region before depressed.

The south felt but slightly these oscillations.

There are thus the following epochs in the Post-tertiary :—the *Drift Epoch ;* the *Laurentian Epoch*, an epoch of depression ; the *Terrace Epoch*, an epoch of elevation ; *three* in number, unless the Drift and Laurentian Epochs are one and the same.

As this particular point is one of much interest in American Geology, I will briefly review some of the facts connected with the drift.

The drift was one of the most stupendous events in geological history. In some way, by a cause as wide as the continent,—and, I may say, as wide nearly as the world,—stones of all sizes, to immense boulders of one or two thousand tons weight, were transported, along with gravel and sand, over hills and valleys, deeply scratching the rocks across which they travelled. Although the ocean had full play in the many earlier ages, and an uneasy earth at times must have produced great convulsions, in no rock strata, from the first to the last, do we find imbedded stones or boulders at all comparable in magnitude with the immense blocks that were lifted and borne along for miles in the Drift epoch.

Much doubt must remain about the origin of the drift, until the courses of the stones and scratches about mountain ridges and valleys shall have been exactly ascertained. The general course from the north is admitted ; but the special facts proving or disproving a degree of dependence on the configuration of the land have not yet been sufficiently studied.

One theory, the most prevalent, supposes a deep submergence over New England and the north and west, even to a depth of four or five thousand feet, and conceives of icebergs as floating along the blocks of stone, and at bottom scratching the rocks. Another, that of the Professors Rogers, objects to such a submergence, and attributes the result to an incursion of the ocean from the north, in consequence of an earthquake movement beneath the Arctic Seas.

The idea of a submergence is objected to on the ground that the sea has left no proof of its presence by fossils, sea shore terraces or beaches.

Unless the whole continent were submerged, of which there is no evidence whatever, there must have been in the Post-tertiary Period an east-and-west line of sea-shore, say across New Jersey, Pennsylvania, Southern Ohio, and the other States west, or still farther south; and yet no such sea-shore marks now exist to trace its outline, although the ocean must have been a portion of the same that had laid up the Cretaceous and Tertiary beds along the coasts, and, in fact, already contained the oysters and clams and many other species of Mollusks which now exist. Can it be, that, contrary to all the ways of the past, such a grand submergence as this view supposes, placing New England four thousand feet under water, could have transpired without a sea-shore record?

Very many have replied in the affirmative; and one able advocate of this view, who sees no difficulty in the total absence of sea-shore terraces or fossils at all levels above the Laurentian beds, finds in the succeeding epoch sea-shore accumulations in all the terraces of our rivers. Why this wonderful contrast? What withheld the waves from acting like waves in the former case, and gave unbounded licence in the latter?

This much, then, seems plain, that the evidence although negative, is very much like positive proof that the land was not beneath the sea to the extent the explanation of the drift phenomena would require.

There are other objections to this view of submergence. If North America were submerged from the southern boundary-line of the drift far into the Arctic regions, this would have made a much warmer climate for the continent than now; if only half-way, then there is another east-and-west shore line to be traced out, before the fact of the submergence can be admitted. Again, we know how the ice, while a glacier, or along a shore of cliffs, (for all bergs are believed to have once been glaciers,) may receive upon them or gather up heavy blocks of stone, even a thousand tons in weight, and bear them off to distant regions, as now happens in the Northern Atlantic. But we have no reason to believe that the massy foot of a berg could pick up such blocks and carry them twenty miles, to drop them again: and hence the short distance of travel would prove that the bergs were made that short distance to the north, and this implies the existence there of glacier valleys and requires a glacier theory.

But without considering other difficulties, I pass to the inquiry Whether the lands, if not submerged, were at any higher level than now?

There is evidence of striking character, that the regions or coasts over the higher latitudes, in both the northern and southern hemispheres, were once much elevated above their present condition. The *fiords*, or deep coast channels, scores of miles long, that cut up the coast of Norway and Britain, of Maine, Nova Scotia and Greenland, of Western America from Puget's Sound north, of southern South America from Chiloe south, of Van Diemen's Land and other southern islands, are all valleys that could not have been scooped out when filled with the ocean's waters as now; that could have been formed only when the land in those high latitudes, north and south, was elevated till their profound depths were nearly or quite dry. Whether this elevation was in the period of the Post-tertiary has not been precisely ascertained. But as they are proof of a north-and-south system of oscillations, the same that was in action in the Drift epoch, and as the cold that such a change would occasion is not very distinctly apparent in the Tertiary period, and much less in the earlier, we have reason for referrring the greater part of the elevation to that drift era and for believing that the excavation of these fiord valleys was then in progress. Both fiords and drift are alike high-latitude phenomena on all the continents north and south. The change of climate between the Cretaceous and Tertiary, and the absence of Tertiary beds north of Cape Cod, may have been connected with an incipent stage in this high latitude movement.

However this be, there is other evidence in the cold of the Drift period, of some extraordinary cause of cold. The drift in Europe and Britain is generally attributed to glaciers and icebergs during a period of greater cold than now; and the fact of this greater cold is so generally admitted, that it is common to speak of it as the glacial period. Professor Agassiz, moreover has urged for this continent the glacial theory.

In a memoir of great research by Mr. Hopkins of Cambridge, England, the able author maintains that this glacial cold might have been produced over Europe, partly at least, by a diversion of the Gulf Stream from its present position. He seems in his paper to attribute too much effect to the Gulf Stream, and too little to the prevailing currents of the atmosphere. But, setting this aside, it is unfortunate for the hypothesis, that there is no reason to suppose that America was not then as much in the way of such a diversion as now. The small changes of level which the Tertiary and Post-tertiary beds of the Gulf have undergone, prove that the gate of Darien was early closed, and has since continued closed. America, as facts show, has not been submerged since the Tertiary to receive the stream over its surface. If it had been, it would have given other limits to her own drift phenomena; for it is an important fact that these limits in America and Europe show the very same difference in the climates or in the isothermals as that which now exists.*

On the question of the drift, we therefore seem to be forced to conclude, whatever the difficulties we may encounter from the conclusion, that the continent was not submerged, and therefore that icebergs could not have been the main drift agents: that the period was a cold or glacial epoch, and the increase of cold was probably produced by an increase in the extent and elevation of northern lands. Further than this, in the explanation of the drift, known facts hardly warrant our going.

If, then, the Drift epoch was a period of elevation, it must have been followed by a deep submergence to bring about the depression of the continent already alluded to, when the ocean stood four hundred feet deep in Lake Champlain, and a whale—for his bones have been found by the Rev. Z. Thompson of Burlington—was actually stranded on its shores; and when the upper terraces of the rivers was the lower river flat of the valleys. This submergence, judging from the elevated sea-beaches and terraces, was five hundred feet on the St. Lawrence and Lake Champlian; eighty feet at Augusta, Maine; fifty feet at Lubec; thirty at

* Moreover, the Gulf Stream is known to be a deep current, so deep as to be turned around to the northward in part by the submarine slopes of the outer West Indian Islands, and it would have required a submergence of many hundred feet, and moreover a passage quite across the continent into the Arctic seas, to have given the stream a chance over the land: and even then, if the West Indian Islands were not also deeply sunk in the ocean a large part of the current would still have kept its present track in the Atlantic.

Sancoti Head, Nantucket; over one hundred at Brooklyn, N. Y.; and two hundred to two hundred and fifty in Central New England, just north of Massachusetts; while south, in South Carolina, it was but eight or ten feet.

But whence the waters to flood valleys so wide, and produce the great alluvial plain constituting the upper terrace, so immensely beyond the capability of the present streams? Perhaps as has been suggested for the other continent, and by Agassiz for this, from the melting snows of the declining glacier epoch. The frequent absence of fine stratification, so common in the material of this upper terrace, has often been attributed to a glacier origin.

According to this view, the events of the Post-tertiary Period in this country make a single consecutive series, dependent mainly on polar or high-latitude oscillations:—an elevation for the *first* or *Glacial Epoch;* a depression for the *second* or *Laurentian Epoch;* a moderate elevation again, to the present height, for the *third* or *Terrace Epoch.*

The same system may, I believe, be detected in Europe; but, like all the geology of that continent, it is complicated by many conflicting results and local exceptions; while North America, as I have said, is like a single unfolding flower in its system of evolutions.

There is the grandeur of nature in the simplicity to which we thus reduce the historical progress of this continent. The prolonged oscillations of the crust, caused by pressure from the southeast beneath the Atlantic, which reach on through the Palæozoic ages, producing the many changes of level in the Silurian and Devonian, still others of greater frequency in the Carboniferous, and then, as in an outburst of long emprisoned energy, throwing up the range of the Appalachians, with vast effusions of heat through the racked and tortured crust, next go on declining as the Jurassic and Cretaceous Periods pass, and finally fade out in the Tertiary. The northern oscillations, perhaps before in progress, then begin to exhibit their effects over the high temperate latitudes, and continue to the Human Era. The sinking of Greenland, now going on, may be another turn in the movement; and it is a significant fact, that, while we have both there and in Sweden northern changes of level in progress, such great secular movements have nowhere been detected on the tropical parts of the continents.

In deducing these conclusions, I have only stated in order the facts as developed by our geologists. Were there time for a more minute survey of details, the results would stand forth in bolder characters.

The sublimity of these continental movements is greatly enhanced when we extend our vision beyond this continent to other parts of the world. It can be no fortunate coincidence, that has produced the parallelism between the Appalachian system and the grand feature lines of Britain, Norway, and Brazil, or that has covered the north and south alike with drift and fiords. But I will not wander, although the field of study is a tempting one.

In thus tracing out the fact, that there has been a plan or system of development in the history of this planet, do we separate the Infinite Creator from his works? Far from it: no more than in tracing the history of a plant. We but study the method in which Boundless Wisdom has chosen to act in creation For we cannot conceive that to act without plan or order is either a mark of divinity or wisdom. Assuredly it is far from the method of the God of the universe, who has filled all nature with harmonies; and who has exhibited his will and exalted purpose as much in the formation of a continent, to all its details, as in the ordered evolution of a human being. And if man, from studying physical nature, begins to see only a Deity of physical attributes, of mere power and mathematics, he has but to look within at the combination of the affections with intellect, and observe the latter reaching its highest exaltation when the former are supreme, to discover proofs that the highest glory of the Creator consists in the infinitude of his love.

My plan, laid out in view of the limited time of a single address, has led me to pass in silence many points that seem to demand attention or criticism; and also to leave unnoticed the labors of many successful investigators.

There are some subjects, however, which bear on general geology, that should pass in brief review.

I. The rock-formations in America may in general be shown to be synchronous approximately with beds in the European series But it is more difficult to prove that castastrophes were synchronous, that is, revolutions limiting the ages or periods.

The revolution closing the Azoic Age, the *first* we distinctly observe in America, was probably nearly universal over the globe.

An epoch of some disturbance between the Lower and Upper Silurian is recognized on both continents. Yet it was less complete in the destruction of life on Europe than here, more species there surviving the catastrophe; and in this country there was but little displacement of the rocks.

The Silurian and the Devonian Ages each closed in America with no greater revolutions than those minor movements which divided the subordinate periods in those ages. Prof. Hall observes that they blend with one another, and the latter also with the Carboniferous, and that there is no proof of contemporaneous catastrophes giving them like limits here and in Europe.

But after the Carboniferous, came the Appalachian revolution, one of the most general periods of catastrophe and metamorphism in the earth's history. Yet in Europe the disturbances were far less general than with us, and occured along at the beginning and end of the Permian Period.

From this epoch to the close of the Cretaceous, there were no contemporaneous revolutions, as far as we can discover. But the Cretaceous Period terminates in an epoch of catastrophe which was the most universal on record, all foreign Cretaceous species having been exterminated, and all American, with a few doubtful exceptions.* This third general revolution was the prelude to the Mammalian Age. But there is no time to do this subject justice, and I pass on,—merely adding, on account of its interest to those who would understand the first chapter of Genesis, that there is no evidence whatever in Geology, that the earth, after its completion; passed through a chaos and a six day's creation at the epoch immediately preceding man, as Buckland, in the younger days of the science, suggested, on *Biblical*, not on Geological, ground. No one pretends that there is a fact or hint in Geology to sustain such an idea; on the contrary, it is utterly opposed to it.

II. The question of the existence of a distinct *Cambrian system* is decided adversely by the American records. The Mollusca in all their grand divisions appear in the subdivisions of the Lower as well as Upper Silurian, and the whole is equally and alike the Molluscan or Silurian Age. The term Cambrian, therefore, if used for fossiliferous strata, must be made subordinate to Silurian.

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* This catastrophe may not have been violent; it may have been ages in accomplishment; yet it was disastrous to the living tribes over the whole sphere.

The *Taconic system* of Emmons has been supposed by its author to have a place inferior to the Cambrian of Sedgwick, or else on a level with it. But the investigations of Hall, Mather and Rogers, and more lately of Logan and Hunt, have shown that the Taconic slates belong with the upper part of the Lower Silurian, being, in fact, the Hudson River shales, far from the bottom of the scale.

III. The American rocks throw much light on the origin of coal. Professor Henry D. Rogers, in an able paper on the American coal-fields, has well shown that the condition of a delta or estuary for the growth of the coal-plants, admitted even now by some eminent geologists, is out of the question, unless the whole continent may be so called; for a large part of its surface was covered with the vegetation. Deltas exist where there are large rivers; and such rivers accumulate and flow where there are mountains. How, then, could there have been rivers, or true deltas of much size, in the Coal Period, before the Rocky Mountains or Appalachians were raised? It takes the Andes to make an Amazon. This remark has a wider application than simply to the Coal Era.

IV. In this connection, I add a word on the idea that the rocks of our continent have been supplied with sands and gravel from a continent now sunk in the ocean. No facts prove that such a continent has ever existed, and the whole system of progress, as I have explained, is opposed to it. Moreover, gravel and sands are never drifted away from sea-shores, except by the very largest of rivers, like the Amazon; and with these, only part of the lightest or finest detritus is carried far away; for much the larger part is returned to the coast through tidal action, which has a propelling movement shoreward, where there are soundings. The existence of an Amazon on any such Atlantic continent in Silurian, Devonian, or Carboniferous times, is too wild an hypothesis for a moment's indulgence.

V. The bearings of the facts in American Palæontology on the science, might well occupy another full discourse. I will close with brief allusions to some points of general interest.

1. The change in the Fauna of the globe as the Age of Man approaches, is one of the most interesting facts in the earth's history. It was a change not in the types of the races, (for each continent retains its characteristic,) but a remarkable dwindling in the size of species. In North America the Buffalo became

the successor to the huge Mastodon, Elephant, and the Bootherium; the small Beaver to the great Castoroides; and the existing Carnivora are all comparatively small.

Parallel with this fact, we find that in South America, as Dr. Lund observes, where, in the last age before Man, there were the giant Megatherium and Glyptodon, and other related Edentates, there are now the small Sloths, Armadillos, and Anteaters.

So, also, on the Oriental continent, the gigantic Lion, Tiger, Hyena, and Elephant, and other monster quadrupeds, have now their very inferior representatives.

In New Holland, too, the land of Marsupials, there are Marsupials still, but of less magnitude.

2. This American continent has contributed to science a knowedge of some of the earliest traces of Reptiles,—the species of the Pennsylvania coal formation, described by Mr. King and Mr. Lea, and others from the Nova Scotia coal-fields, discovered by Messrs. Dawson and Lyell.

It has afforded the earliest traces of birds thus far deciphered in geological history,—the colossal and smaller waders, whose tracks cover the clayey layers and sandstone of the Jurassic rocks in the Connecticut valley. The earliest Cetacea yet known are from he American Cretaceous beds, as described by Dr. Leidly. And among the large Mammals which had had posession of the renewed world after the Cretaceous life had been swept away, the largest, as far as has been ascertained, lived on this continent. The Palæotheria of the Paris Basin, described by Cuvier, were but half the size of the allied Titanotheria of Nebraska.

But here our boasting ceases, for, as Agassiz has shown, the present Fauna of America is more analogous to the later Tertiary of Europe than to the existing species of that continent.

In the Palæozoic Ages,to theclose of the Coal Period, the Americancontinent was as brilliant and perhaps as profuse in its life as any other part of the world. It was a period, indeed, when the globe was in an important sense a unit, not individualized in its climates or its distribution of life, and only partially in its seas. But from this time the contrast is most striking.

The whole number of known American species of animals of the Permian,Triassic, JurassicCretaceous,and Tertiary Periods is about two thousand; while in Britain and Europe, a territory even smaller, there were over twenty thousand species. In the Permian we have *none*, while Europe has over two hundred species.

In the Triassic, *none ;* Europe, one thousand species. In the Jurassic, (the supposed Triassic here included) sixty ; Europe, over four thousand. In the Cretaceous, three hundred and fifty to four hundred : Europe, five to six thousand. In the Tertiary, hardly fifteen hundred ; Europe, about eight thousand.

America, since Palæozoic times, has therefore been eminent for the poverty of its Fauna.

Again : the Mammalian Age in America, although commencing with huge Pachyderms, shows little progress afterward. The larger quadrupeds continue to be mostly herbivorous, and the Carnivora, the higher group, are few and of comparatively small size. *The Herbivora are still the typical species.* While in Europe and Asia, at the same time,—that is, in the Post-tertiary,—the Carnivora are of great size and ferocity, far exceeding the largest of modern Lions and Tigers, and they exist in immense numbers. The single species of Lion described by Dr. Leidy, from a bone from near Natchez, hardly lessens the contrast.

South America, as has been remarked by Agassiz and others, sustains the inferior position of America. The huge Sloths, Megatheria, and other Edentates of the South, are even lower in grade than the ordinary Herbivora, and place that Southern continent at an inferior level in the scale. Although there were Carnivora, they were much smaller than the European. *The Edentates are its typical species.*

The supremacy of the great Oriental continent is, therefore, most signally apparent.

The contrast is still greater with Australia and New Zealand, whose past and present Fauna and Flora have been well said by Agassiz and Owen to represent the Jurassic Period,—the present era affording Trigonias, Terebratulæ, Cestraciont Fishes, and the Araucarian Coniferæ, all Jurassic types, besides Kangaroos and Moas. Among Mammals, as is well known, *the Marsupials,* the lowest of all in the class, *are its typical species.*

Ever since Palæozoic times, therefore, the Oriental Continent, —that is Europe, Asia, and Africa combined,—has taken the lead in animal life. Through the Reptilian Age, Europe and Asia had species by thousands, while America was almost untenanted. In the later Mammalian Age, North America was yet in the shade, both in its Mammals and lower tribes; South America in still darker shadows; and Australia even deeper still. The earth's antipodes were like light and darkness in their zoological contrasts. And was there not in all this a prophetic indication, which had long been growing more and more distinct, that the Eastern Continent would be man's chosen birthplace? that the long series of living beings, which had been in slow progression through incalculable ages, would there at last attain its highest exaltation? that the stupendous system of nature would there be opened to its fullest expansion?

Another of our number has shown in eloquent language how the diversified features and productions of the Old World conspired to adapt it for the childhood and development of the race; and that, when beyond his pupilage, having accomplished his rescue from himself and the tyranny of forces around him, and broken the elements into his service, he needed to emerge from the trammels of the school-house in order to enjoy his fullest freedom of thought and action, and social union. Professor Guyot observes farther, that America, ever free, was the appointed land for this freedom and union,—of which its open plains, and oneness of structure, were a fit emblem; and that, although long without signs of progress or hope in its future, this land is to be centre of hope and light to the world.

In view of all these arrangements, man may well feel exalted. He is the last of the grand series. At his approach, the fierce tribes of the earth drew back, and the race dwindled to one-fourth its bulk and ferocity,—the huge Mastodons, Lions, and Hyenas yielding place to other species, better fit to be his attendants, and more in harmony with the new creation. Partaking of the Divine image, all nature pays him tribute; the universe is his field of study; an eternity his future. Surely it is a high eminence on which he stands.

Yet he is only *one* of the series; one individuality in the vast system. How vain the philosophy which makes the creature the God of nature, or nature its own author! Infinitely beyond man, infinitely beyond all created things, is that Being with whom this system, and the combined systems of immensity, were as one purpose of His will.*

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* This Address, exclusive of the notes, is cited from the Proceedings of the Amer. Assoc. IXth Meeting at Providence, R. I. It was delivered by the author on retiring from the duties of President.

ARTICLE LVII.—*On the several species of Squirrels inhabiting the British Provinces.*

Description of the Genus.

GENUS SCIURUS.—Linn., Erxleb., Cuv., Geoff., Illiger.

Dental Formula.

Incisive, $\frac{2}{2}$; *Canine*, $\frac{0}{0}$—$\frac{0}{0}$; *Molar* $\frac{4}{4}$—$\frac{4}{4}$ or $\frac{5}{4}$—$\frac{5}{4}$ = 20 or 22.

Body elongated; tail long and furnished with hairs; head large; ears erect; eyes projecting and brilliant; upper lip divided. Four toes before, with a tubercle covered by a blunt nail; five toes behind. The four grinders, on each side the mouth above and beneath, are variously tuberculated; a very small additional one in front, above, is in some species permanent, but in most cases drops out when the young have attained the age of from six to twelve weeks. Mammæ, eight; two pectoral, the others abdominal.

The squirrel is admirably adapted to a residence on trees, for which nature has designed it. Its fingers are long, slender and deeply cleft, and its nails very acute and greatly compressed; it is enabled to leap from branch to branch, and from tree to tree, clinging to the smallest twigs, and seldom missing its hold. When this happens to be the case, it has an instinctive habit of grasping in its descent at the first object which may present itself, or if about to fall to the earth, it spreads itself out in the manner of the flying squirrel, and thus by presenting a greater resistance to the air, is enabled to reach the ground without injury, and recover itself so instantaneously, that it often escapes the teeth of the dog that watches its descent, and stands ready to seize upon it at the moment of its fall. It immediately ascends a neighbouring tree, emitting very frequently a querulous bark, which is either a note of fear or of triumph.

Although the squirrel moves with considerable activity on the ground, it rather runs than leaps; on trees, however, its activity and agility are surprising, and it is generally able to escape from its enemies, and conceal itself in a few moments, either among the thick foliage, in its nest, or in a hollow tree. The squirrel usually conveys its food to the mouth by the fore-paws. Nuts, and seeds of all kinds, are held by it between the rudimental thumbs and the inner portions of the palms. When disturbed or alarmed, it either drops the nut and makes a rapid retreat, or seizes it with the incisors, and carries it to its hole or nest.

All our American species of this genus, as far as we have been able to become acquainted with their habits, build their nests either in the fork of a tree, or on some secure portion of its branches. The nest is hemispherical in shape, and is composed of sticks, leaves, the bark of trees, and various kinds of mosses and lichens. In the vicinity of these nests, however, they have a still more secure retreat in some hollow tree, to which they retire in cold or in very wet weather, and where their first litter of young is generally produced.

Several species of squirrels collect and hide away food during the abundant season of autumn, to serve as a winter store. This hoard is composed of various kinds of walnuts and hickory nuts, chesnuts, chinquepins, acorns, corn, &c., which may be found in their vicinity. The species, however, that inhabit the Southern portions of the United States, where the ground is seldom covered with snow, and where they can always derive a precarious support from the seeds, insects, and worms, which they scratch up among the leaves, &c., are less provident in this respect; and of all our species, the chickaree, or Hudson's Bay squirrel (Sc. *Hudsonius*) is by far the most industrious, and lays up the greatest quantity of food.

In the spring, the squirrels shed their hair, which is replaced by a thinner and less furry coat; during summer their tails are narrower and less feathery than in autumn, when they either receive an entirely new coat, or a very great accession of fur; at this season also, the outer surfaces of the ears are more thickly and prominently clothed with fur than in the spring and summer.

Squirrels are notorious depredators on the Indian corn fields of the farmer, in some portions of our country, consuming great quantities of this grain, and by tearing off the husks, exposing an immense number of the unripe ears to the mouldering influence of the dew and rain.

The usual note emitted by this genus is a kind of tremulous querulous bark, not very unlike the quacking of a duck. Although all our larger squirrels have shades of difference in their notes, which will enable the practised ear to designate the species even before they are seen, yet this difference cannot easily be described by words. Their bark seems to be the repetition of a syllable five or six times, quack-quack-quack-quack-qua—commencing low, gradually raising to a higher pitch, and ending with a drawl on the last letter in the syllable. The notes, however, of the smaller

Hudson's Bay squirrel, and its kindred species existing on the Rocky Mountains, differ considerably from those of the larger squirrels; they are sharper, more rapidly uttered, and of longer continuance; seeming intermediate between the bark of the latter and the chipping calls of the ground-squirrels, (TAMIAS.) The barking of the squirrel may be heard occasionally in the forest during all hours of the day, but is uttered most frequently in the morning and afternoon. Any sudden noise in the woods, or the distant report of a gun, is almost certain, during fine weather, to be succeeded by the barking of the squirrel. This is either a note of playfulness or of love. Whilst barking it seats itself for a few moments on a branch of a tree, elevates its tail over its back towards the head, and bending the point backwards continues to jerk its body, and elevate and depress the tail at the repetition of each successive note. Like the mocking bird and the nightingale, however, the squirrel, very soon after he begins to sing, (for to his own ear, at least, his voice must be musical,) also commences skipping and dancing; he leaps playfully from bough to bough, sometimes pursuing a rival or his mate for a few moments, and then reiterating with renewed vigour his querulous and monotonous notes.

One of the most common habits of the squirrel is that of dodging around the tree when approached, and keeping on the opposite side, so as to completely baffle the hunter who is alone. Hence it is almost essential to the sportsman's success, that he should be accompanied by a second person, who, by walking slowly round the tree on which the squirrel has been seen, and beating the bushes, and making a good deal of noise, causes him to move to the side where the gunner is silently stationed, waiting for a view of him to fire. When a squirrel is seated on a branch, and fancies himself undiscovered, should some one approach, he immediately depresses his tail, and extending it along the branch behind him, presses his body so closely to the bark, that he frequently escapes the most practised eye. Notwithstanding the agility of these animals, man is not their only, nor even their most formidable enemy. The owl makes a frequent meal of those species which continue to seek their food late in the evening and early in the morning. Several species of hawks, especially the red-tailed, (*Buteo borealis,*) and the red-shouldered, (*Buteo lineatus,*) pounce upon them by day. The black snake, rattle snake, and other species of snakes, can secure them; and the ermine, the fox, and the wild cat, are incessantly exerting their sagacity in lessening their numbers.

The generic name Sciurus is derived from the Latin *sciurus*, a squirrel, and from the Greek *skiouros*, from *skia*, a shade, and *oura*, a tail.

There are between sixty and seventy species of this genus known to authors; about twenty well determined species exist in North America. (*Aud & Bach.*)

There are only three species of the above described genus known in Canada, namely the Red Squirrel, *Sciurus Hudsonius*, the Black Squirrel, *Sciurus niger*, and the northern Gray Squirrel, *Sciurus migratorius*. We mean by the above, that only these three of our small quadrupeds properly belong to the group, technically designated by the generic name here given. There are others, such as the small striped Squirrel or Chip Muck and the Flying Squirrel, which, although closely related to *Sciurus* proper, and bearing the same common name, yet are considered sufficiently distinct to be otherwise classified. The former is therefore placed in the genus Tamias, and the latter in that of Pteromys, both of which we shall have occasion to describe hereafter.

The Gray Squirrel.

The Gray Squirrel *Sciurus migratorius*, is about twenty-two inches in length, the body being twelve inches, and the tail without the long terminal hairs ten. The colour varies greatly, but in general, the true grey variety has the sides neck and hips light gray, the nose, cheeks, a space round the eyes, the upper surface of the feet, and a stripe along the sides, yellowish brown. On the back, there is an obscure stripe of brown. The hairs for one half of their length at base are dark cinerous, then a narrow mark of black, and are tipped with white. There is a variety which has the whole upper surface dark brownish black. It is often found in the same nest which contains the family of the gray parents.

This species constructs its nest of small branches, twigs, leaves and moss, in the fork of a tree, or in some convenient place upon a large branch. The materials are not sought upon the ground, but in the tree top, where both male and female employ themselves actively all day long, breaking off the dry twigs, and even gnawing through the small green branches. The young are brought forth in May or June, and soon attain sufficient size and strength to leave the nest. The whole of the young family may be often seen clinging around or playing about the same tree, and when alarmed, all run into some small hole and disappear; sometimes one may be seen with his head at the hole curiously watching the intruder upon their sports.

The Gray Squirrel it is said does not lay up a hoard of winter provisions. It is known to feed on the larvae of various species of insects, but its principal food consists of nuts, seeds and grain. The hard shell of the hickory nut affords no protection to the embryo tree within, against the sharp incisors of this squirrel. The animal first gnaws off the thick pericarp of the nut and then makes a small hole in the thinnest part of the shell immediately over the kernel, through which it is all completely extracted. This is performed in an incredibly short space of time, and one squirrel will soon destroy what in course of time might have grown into a forest of some acres in extent. It is particularly fond of young Indian corn, and squirrel hunts got up by the farmers in retaliation are too well known to need any description here.

The enemies of this species are the fox, weasel, lynx, red tailed hawk, &c. The latter, when unaccompanied by his mate, finds it no easy undertaking to accomplish the capture, as the nimble squirrel twists and dodges around the tree or large branch so quickly that the hawk, after an hour's baffling, is forced to retire from sheer exhaustion. It is said, however, that these birds sometimes hunt in couples, and then the squirrel falls an easy prey, as in dodging away from one of his pursuers he often springs within reach of the talons of the other. This animal is remarkable for the extent of its migrations, which appear to have been more frequent in former times than at present.

Audubon says, "the farmers in the Western wilds regard them with sensations which may be compared to the anxious apprehensions of the Eastern nations at the flight of the devouring locust. At such periods, which usually occur in autumn, the squirrels congregate in different districts of the far North-west; and in irregular troops make their way instinctively in an eastern direction. Mountains, cleared fields, the narrow bays of some of our lakes, or our broad rivers, present no unconquerable impediments. Onward they come, devouring on their way every thing that is suited to their taste, laying waste the corn and wheat-fields of the farmer; and as their numbers are thinned by the gun, the dog, and the club, others fall in and fill up the ranks, till they occasion infinite mischief, and call forth more than empty threats of vengeance. It is often inquired, how these little creatures, that on common occasion have such an instinctive dread of water, are enabled to cross broad and rapid rivers, like the Ohio and Hudson for instance. It has been asserted by authors, and is believed by many, that they carry to the shore a suitable piece of bark, and seizing the opportunity of a favourable breeze, seat themselves upon this substitute for a boat, hoist their broad tails as a sail, and float safely to the opposite shore. This, together with many other traits of intelligence ascribed to this species, we suspect to be apocryphal. That they do migrate at irregular, and occasionally at distant periods, is a fact sufficiently etablished; but in the only two instances in which we had opportunities of witnessing the migrations of these squirrels, it appeared to us, that they were not only unskilful sailors but clumsy swimmers. One of these occasions, (as far as our recollection serves us) was in the autumn of 1808 or 1809; troops of squirrels suddenly and unexpectedly made their appearance in the neighbourhood; among them were varieties not previously seen in those parts; some were broadly striped with yellow on the sides, and a few had a black stripe on each side, bordered with yellow or brown, resembling the stripes on the sides of the Hudson's Bay squirrel, (*S. Hudsonius.*) They swam the Hudson in various places between Waterford and Saratoga; those which we observed crossing the river were swimming deep and awkwardly, their bodies and tails wholly submerged; several that had been drowned were carried downwards by the stream, and those which were so fortunate as to reach the opposite bank were so wet and fatigued, that the boys stationed there with clubs found no difficulty in securing them alive or in killing them. Their migrations on that occasion did not, as far as we could learn, extend farther eastward than the mountains of Vermont; many remained in the county of Rensselaer, and it was remarked that for several years afterwards squirrels were far more numerous there than before. It is doubtful whether any ever return to the west, as finding forests and food suited to their taste and habits, they take up their permanent residence in their newly explored country, where they remain and propagate their species, until they are gradually thinned off by the increase of inhabitants, new clearings, and the dexterity of the sportsmen around them. The other instance occurred in 1819, when we were descending the Ohio river in a flat-boat, or ark, chiefly with the intention of seeking for birds then unknown to us. About one hundred miles below Cincinnati, as we were floating down the stream, we observed a large number of squirrels swimming across the river, and we continued to see them at various places, until we had nearly reached Smithland, a town not more than about one hundred miles above the mouth of the Ohio.

At times they were strewed, as it were, over the surface of the water, and some of them being fatigued sought a few moments' rest on our long "steering oar," which hung into the water in a slanting direction over the stern of our boat. The boys, along the shores and in boats were killing the squirrels with clubs in great numbers, although most of them got safe across. After they had reached the shore, we saw some of them trimming their fur on the fences or on logs of drift-wood.

We kept some of these squirrels alive; they were fed with hickory nuts, pecans, and ground or pea-nuts, (*Arachis hypo œa.*) Immediately after eating as much as sufficed for a meal, they hid away the remainder beneath the straw and cotton at the bottom of their cage in a little heap A very tame and gentle one we had in a room at Shippingport, near Louisville, Kentucky, one night ate its way into a bureau, in which we had a quantity of arsenic in powder, and died next morning a victim to curiosity or appetite, probably the latter, for the bureau also contained some wheat.

Geographical Distribution. — Occurs as far north as the Hudson's Bay; in Upper Canada, along the St. Lawrence and westward. Never seen in the valley of the Ottawa; does not exist in Lower Canada nor in the Southern States, nor as far west as the Rocky Mountains.

THE BLACK SQUIRREL.

Sciurus Niger.—*Linn.*

"Head a little shorter and more arched than that of the Northern gray squirrel; incisors compressed, strong, and of a deep orange colour anteriorly; ears elliptical and slightly rounded at the tip, thickly clothed with fur on both surfaces, the fur on the outer surface extending three lines beyond the margin; there are, however, no distinct tufts; whiskers a little longer than the head; tail long, not very distichous, thickly clothed with moderately close hair; the fur is softer than that of the Northern gray squirrel;" colour black, with a few white tufts of hair interspersed.

This species is found all along the St. Lawrence and great lakes, but only occasionally in the valley of the Ottawa. It does not occur in Lower Canada, Nova Scotia or New Brunswick. There appears to be some doubt as to the extent of territory west of the lakes, over which the range of this squirrel extends, some authors having confused the subject by describing animals as occurring in various places in the west, which cannot be distinguished by the descriptions from the black variety of the gray squirrel. The habits do not appear to be different from those of *S. Migratorius*, and it is a somewhat larger species.

The black squirrel was unknown in the neighbourhood of the City of Ottawa for more than thirty years after the place became inhabited by the white men, and although of late a few are seen every year, yet still they cannot be said to have regularly established themselves in that thriving quarter. It appears to us, that it is to the settlement of the tract of country lying between the St. Lawrence and the Ottawa that the appearance of this species upon the banks of the latter stream must be attributed. In Western Canada they are at times exceedingly numerous.

THE RED SQUIRREL.

Sciurus Hudsonius.—*Pennant.*

This species is a third smaller than the gray squirrel, tail shorter than the body, ears slightly tufted, colour, reddish above, white beneath. It has only four molar teeth in the upper jaw on each side, while many of the other species have five. The forehead is slightly arched; the nose obtuse; eyes of moderate size; ears, broad rounded, clothed on both sides with short hairs, not distinctly tufted like those of the European squirrel, to which it has been referred, although the hairs when the animal has its winter pelage, project beyond the margins and resemble tufts; whiskers a little longer than the head; the body presents the appearances of lightness and agility; the tail is somewhat depressed, and linear, not as bushy as in most other squirrels, but capable of a distichious arrangement; limbs robust; claws, compressed sharp, slightly hooked; third toe a little the longest; palms and under surface of the toes naked; soles of hind feet clothed with hairs, except on the tubercles at the root of the toes."

The colour is deep reddish brown on the whole of the upper surface lips, chin, throat, inside of legs and belly white. There is sometimes a black line running from near the shoulders along the sides to near the thighs.

It is in some parts of the country called the Chickaree, and its habits are thus sketched by the learned authors of the quadrupeds of America.

"The Hudson's Bay squirrel is fearless, and heedless, to a great degree, of the presence of man; we have had one occasionally pass through our yard, sometimes ascending an oak or a chesnut, and proceeding leisurely through our small woody lawn. These little animals are generally found singly, although it is not uncommon for many to occupy the same piece of wood-land, if of any extent. In their quick, graceful motions from branch to branch, they almost remind one of a bird, and they are always neat and cleanly in their coats, industrious, and well provided for the cold of winter.

"In parts of the country, the Chickaree is fond of approaching the farmers store-houses of grain, or other products of the fields, and occasionally it ventures even so far as to make a nest for itself in some of his out-buildings, and is not dislodged from such snug quarters without undergoing a good deal of persecution.

"One of these squirrels made its nest between the beams and the rafters of a house of the kind we have just spoken of, and finding the skin of a peacock in the loft, appropriated the feathers to compose its nest, and although it was destroyed several times, to test the perseverance of the animal, it persisted in re-constructing it. The Chickaree obtained this name from its noisy chattering note, and like most other squirrels, is fond of repeating its cries at frequent intervals. Many of the inhabitants of our Eastern States refuse to eat squirrels of any kind, from some prejudice or other; but we can assure our readers that the flesh of this species, and many others, is both tender and well-flavoured, and when nicely broiled, does not require a hunter's appetite to recommend it.

"The habits of this little squirrel are, in several particulars, peculiar; whilst the larger gray squirrels derive their sustenance from buds and nuts, chiefly inhabit warm or temperate climates, and are constitutionally fitted to subsist during winter on a small quantity of food, the Chickaree exhibit the greatest sprightliness and activity amidst the snows and frosts of our Northern regions and consequently is obliged, during the winter season, to consume as great a quantity of food as at any other. Nature has, therefore, instructed it to make provision in the season of abundance for the long winter that is approaching; and the quantity of nuts and seeds it often lays up in its store-house, is almost incredible. On one occasion we were present, when a bushel and a half of shell-barks (*Carya alba,*) and chesnuts, were taken from a hollow tree occupied by a single pair of these industrious creatures; although generally the quantity of provision laid up by them is considerably less. The Chickaree has too much foresight to trust to a single hoard, and it often has several, in different localities among the neighbouring trees, or in burrows dug deep in the earth. Occasionally these stores are found under leaves, beneath logs, or in brush-heaps, at other times they are deposited in holes in the ground; and they are sometimes only temporarily laid by in some convenient situation, to be removed at leisure. When, for instance, nuts are abundant in the autumn, large quantities in the green state, covered by their thick envelope, are collected in a heap near the tree whence they have fallen; they are then covered up with leaves, until the pericarp, or thick outer covering, either falls off or opens, when the Squirrel is able to carry off the nuts more conveniently. In obtaining shell-barks, butter-nuts, (*Juglans cinerea*) chesnuts, hazelnuts, &c., this squirrel adopts the mode of most of the other species. It advances as near to the extremity of the branch as it can with safety, and gnaws off that portion on which the nuts are dependent. This is usually done early in the morning, and the noise occasioned by the falling of large bunches of chesnut burrs, or clusters of butter-nuts, hickory, or beech-nuts, thus detached from the parent stem, may be heard more than a hundred yards off. Some of the stems attached to the nuts are ten inches or a foot in length. After having thrown down a considerable quantity, the squirrel descends and drags them into a heap, as stated above.

"Sometimes the hogs find out these stores, and make sad havoc in the temporary depot. But Providence has placed much food of a different kind within reach of the red-squirrel during winter. The cones of many of our pines and firs in high northern latitudes are persistent during winter; and the Chickaree can be supported by the seeds they contain, even should his hoards of nuts fail. This little squirrel seems also to accommodate itself to its situation in another respect. In Pennsylvania, and the southern part of New York, where the winters are comparatively mild, it is very commonly satisfied with a hollow tree as a winter residence; but in the latitude of Saratoga, N. Y., in the northern part of Massachusetts, in New Hampshire, Maine, Canada, and farther north, it usually seeks for additional protection from the cold, by forming deep burrows in the earth. Nothing is more common than to meet with five or six squirrel holes in the ground, near the roots of some white pine or hemlock; and these retreats can be easily found by the vast heaps of scales from the cones of pines and firs, which are in process of time accumulated around them. This species can both swim and dive. We once observed some lads shaking a red-squirrel from a sapling that grew on the edge of a mill-pond. It fell into the water, and swam to the opposite shore, performing the operation of swimming moderately well, and reminding us by its movements of the meadow-mouse, when similarly occupied. It was " headed " by its untiring persecutors, on the opposite shore, where on being pelted with sticks, we noticed it diving two or three times, not in the graceful curving manner of the mink, or musk-rat, but with short and ineffectual plunges of a foot or two at a time.

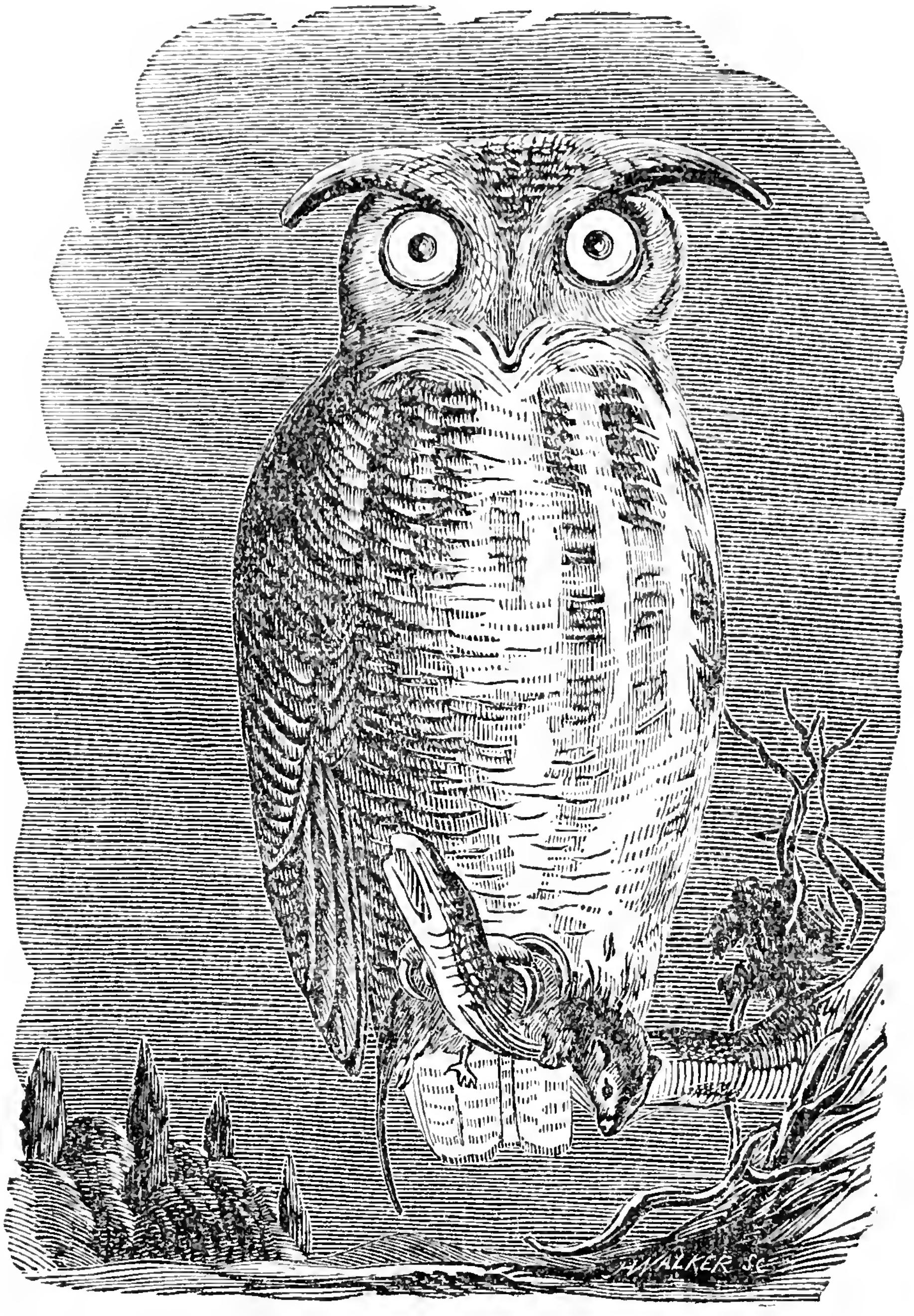
" We have kept the Chickaree in cages, but found it less gentle, and more difficult to be tamed than many other species of the genus.

" Richardson informs us that in the fur countries, " the Indian boys kill many with the bow and arrow, and also take them occasionally with snares set round the trunks of the trees which they frequent. " We have observed that during winter a steel-trap baited with an ear of corn, (maize,) placed near their burrows at at the foot of large pine or spruce trees, will secure them with the greatest ease.

" The limits of the northern range of this species are not precisely determined, but all travellers who have braved the snows of our Polar regions, speak of its existence as far north as their journeys extended. It has been observed in the 68th or 69th parallel of latitude; it also exists in Labrador, Newfoundland and Canada. It is the most common species in New England and New York, and it is by no means rare in Pennsylvania and New Jersey, especially in the hilly or mountainous portions of the latter state. It is seen, in diminished numbers, in the mountains of Virginia, although in the alluvial parts of that State, it is scarcely known; as we proceed southwardly, it becomes more rare, but still continues to be met with on the highest mountains. The most southern locality to which we have traced it, is a high peak called the Black mountain, in Buncombe county, N. Carolina. The woods growing in that elevated situation are in some places wholly composed of balsam-fir trees, (*Abies balsamea*,) on the cones of which these squirrels feed. There this little animal is quite common, and has received a new English name, viz., that of "Mountain boomer." Toward the west we have traced it to the mountains of Tennessee; beyond the Rocky mountains, it does not exist. In the Russian settlements on the Western coast, it is replaced by the Downy Squirrel, (*Sc. lanuginosus.*) In the vicinity of Columbia, and for several hundred miles along the mountains South of that river, by RICHARDSON'S Columbian squirrel; and in the mountainous regions bordering on California, by another small species much resembling it, which we hope, hereafter, to present to our readers.

"Although this species from its numbers and familiarity, as well as from its general diffusion, has been longer known than any other of our squirrels, and has been very frequently described, it has, with few exceptions, retained its name of *Hudsonius.* ERXLEBEN supposed it to be only a variety of the common squirrel, *S. vulgaris*, of Europe, and so describes it. The *Sciurus Hudsonius* of GMELIN is a flying squirrel, (*Pteromys sabrinus*,) and the Carolina gray squirrel, which in Shaw's General Zoology, vol. ii., p. 141, is given as a variety of *Sciurus Hudsonius*, is our own species, (*Sc. Carolinensis*). This species was unknown to LINNÆUS. PALLAS appears to have been the first author, who gave the specific name of *Hudsonius*, (see Pall. Glir. p. 377, A. D. 1786, and GMELIN, in 1788, adopted his name.)

"In examining the form, and inquiring into the habits of this species; we cannot but observe a slight approach to TAMIAS, and a more distant one to SPERMOPHILUS. Its ears are placed farther back than in the squirrels generally, its tail is only sub-distichous, and withal it often digs its own burrow, and lives indiscriminately in the ground and on trees. In all these particulars it appears, in connexion with the Downy squirrel, (*Sc. lanuginosus*,) to form a connecting link between SCIURUS and TAMIAS. It has, however, no cheek pouches, and does not carry its food in its cheeks in the manner of the TAMIÆ and SPERMOPHILI, but between its front teeth, like the rest of the squirrels."



ARTICLE LVIII.—*On the great Horned Owl, Bubo Virginianus.*

GENUS BUBO.—Cuvier.

Generic Characters.

Bill short, stout, broader than high at the base, compressed toward the upper end; upper mandible with its dorsal line curved from the base, the edges with a slight festoon, the tip trigonal, very acute; lower mandible with the dorsal line convex, the tip obliquely truncate; nostrils broadly elliptical, aperture of ear elliptical, less than half the height of the head, without operculum; feet of ordinary length; tarsi and toes feathered; Plumage full and very soft; facial disks complete; a tuft of elongated feathers on each side of the crown of the head; wings ample, the first quill short, the fourth longest; tail of ordinary length, rounded.

The Great Horned Owl.

Bubo Virginianus.

This beautiful and majestic bird was called by Buffon, Duc de Virginie; by the Cree Indians, Netowky—Omeesew, and according to Sir John Richardson, by the Indians of the plains of the Sascatchewan, Otowack Oho. The savages it is said hold it in great respect, as a bird of evil omen, and carry this superstition so far as to be displeased with any one who imitates the unearthly hootings of this midnight marauder.

Wilson, who never looses an opportunity of pleading affectionnately for his Owls and Woodpeckers, remarks that there is something in the character of the Owl so recluse, solitary and mysterious, something so discordant in the tones of its voice, heard only amid the silence and gloom of night, and in the most lonely and sequestered situations, as to have strongly impressed the minds of mankind in general with sensations of awe and abhorrence of the whole tribe. The poets have indulged freely in this general prejudice; and in their descriptions and delineations of midnight storms and gloomy scenes of nature, the Owl is generally introduced to heighten the picture. Ignorance and superstition in all ages and in all countries listen to the voice of the Owl, and even contemplate its physionomy with feelings of disgust and a kind of fearful awe. The priests or conjurors among some of our Indian nations, have taken advantage of the reverential honor for this bird, and have adopted the great Horned Owl, the subject of the present account, as the symbol or emblem of their office.

" Among the Creeks, the junior priests or students constantly wear a white mantle, and have a great Horned Owl skin, cased and stuffed very ingeniously, so well executed as almost to appear like the living bird, having large sparkling glass beads, or buttons fixed in the head for eyes. This insignia of wisdom and divination they wear sometimes as a crest on the top of the head; at other times, the image sits on the arm or is borne in the hand. These bachelors are also distinguished from other people by their taciturnity, grave and solemn countenance, dignified step, and singing to themselves songs or hymns in a low sweet voice, as they strole about the town.

Nothing is a more effectual cure for superstition than a knowledge of the general laws and productions of nature, no more forcibly leads our reflections to the first great self existent CAUSE of all, to whom our reverential love is then humbly devoted, and not to any of his dependent creatures, with all the gloomy habits and ungracious tones of the Owl, there is nothing in this bird supernatural or mysterious, or more than that of a simple bird of prey, formed for feeding by night, like many other animals, and of reposing by day. The harshness of its voice occasioned by the width and capacity of its throat, may be intended by heaven as an alarm and warning to the birds and animals on which it preys, to secure themselves from danger. The voices of all carnivorous birds and animals are also observed to be harsh and hideous, probably for this very purpose."

A good specimen of the great Horned Owl, taken in winter when his plumage is in its most full state of thickness and softness, is one of the most handsome of American birds. The length is nearly two feet; the long plume like tufts, or horns as they are called, several inches in length, and the whole body richly barred and variegated with white, brown and tawney colours. The eyes are large yellow, flashing with a golden light when excited, and the whole bearing fearless and noble.

This species lives retired in the most secluded recesses of the forest, but often sallies forth at night on a tour of inspection, around the barn where now and then some unlucky fowl becomes his prey. His strength is sufficiently great to enable him to capture and destroy birds several times his own bulk, and consequently the common barn fowls are easily carried away to his haunt in the woods. Wild turkeys, mallards, guinea fowls, young rabbits, hares, squirrels, mice, partridges, and small birds of all kinds, furnish him with subsistence, and as he hunts while others sleep, no doubt his larder is generally well supplied.

The great Horned Owl begins to pair early in spring, the nest is very long, and built upon a large branch usually, at no great distance from the trunk of the tree. It is composed externally of crooked sticks, and is lined with coarse grasses and some feathers. The whole measures nearly three feet in diameter; the eggs, which are from three to six, are almost globular in form, and a dull white colour. The male assists the female in sitting on the eggs. Only one brood is raised in a season. The young remain in the nest until fully fledged, and afterwards follow the parents for a considerable time, uttering a mournful sound to induce them to supply them with food. They acquire the full plumage of the old birds in the first spring, and until then, are considerably lighter, with more dull buff in their tints. The nest is sometimes made in the hollows of large partially decayed trees, and occasionally in the fissures of rocks. In these cases very little preparation is made previously to the laying of the eggs.

"The flight is elevated, rapid and graceful. It sails with apparent ease; and in large circles, in the manner of an eagle, rises and descends without the least difficulty, by merely inclining its wings or its tail as it passes through the air. Now and then it glides silently close over the earth, with incomparable velocity, and drops, as if shot dead, on the prey beneath. At other times, it suddenly alights on the top of a fence stake, or a dead stump, shakes its feathers, arranges them, and utters a shriek so horrid that the woods around echo to its dismal sound. Now it seems as if you heard the barking of a cur dog; again, the notes are so rough and mingled together, that they might be mistaken for the last gurglings of a murdered person, striving in vain to call for assistance, at another time, when not more than fifty yards distant, it utters its more usual *hoo*, *hoo*, *hoo-e*, in so peculiar an under tone, that a person unacquainted with the notes of this species might easily conceive them to be produced by an owl more than a mile distant. During the utterance of all these unmusical cries, it moves its body and more particularly its head, in various ways, putting them into positions, all of which appear to please it much, however grotesque they may seem to the eye of man. In the interval following each cry, it snaps its bill, as if by way of amusement; or, like the wild boar sharpening the edges of his tusks, it perhaps expects that the action will whet its mandibles.

It roosts by day in thick branching trees, its body being erect, its plumage closed, its tufted head feathers partially lowered, and its head half-turned and resting on one shoulder.

When the sun shines brightly, this bird is easily approached; but if the weather be cloudy, it rises on its feet at the least noise, erects the tufts of its head, gives a knowing kind of nod, flies off in an instant, and generally proceeds to such a distance, that it is difficult to find it again. When wounded, it exhibits a revengeful tenacity of spirit, scarcely surpassed by any of the noblest of the Eagle tribe, disdaining to scramble away like the barred Owl, but facing its enemy with undaunted courage, protruding its powerful talons, and snapping its bill, as long as he continues in his presence. On these occasions, its large goggle eyes are seen to open and close in quick succession, and the feathers of its body, being raised, swell out its apparent bulk to nearly double the natural size." This bird is found all over the United States and the British Provinces, from Texas to the Artic regions. They are frequently caught in traps set for other animals in Canada, or otherwise killed, and when a bird strictly nocturnal in its habits is thus often met with it may be considered abundant.

DESCRIPTION.

Upper part of the head brownish black, mottled with light brown, the tufts of the same colours, margined with brown; face brownish red, with a circle of blackish brown; upper parts undulatingly banded and minutely mottled with brownish black and yellowish red, behind tinged with grey; wings and tail light brownish yellow, barred and mottled with blackish brown and light brownish red; chin white; upper part of throat light reddish, spotted with black, a band of white across the middle of the fore neck; its lower part and the breast light yellowish red, barred with deep brown, as are the lower parts generally; several longitudinal brownish black patches on the lower fore neck; tarsal feathers light yellowish red, obscurely barred.

Male 23, 56. Female, 25, 60.

Synonims, great Horned Owl, Striæ Virginiana, of Wilson in American ornithology, and by other authors.

ARTICLE LIX. *The Snowy Day Owl. Surnia Nyctea.*

GENUS SURNIA.—(Dumeril.)

GENERIC CHARACTERS.—Bill very short, strong, its upper outline decurved from the base; lower mandible abruptly rounded, with a sinus on each side. Nostrils elliptical, rather large. Aperture of ear elliptical, simple, not more than half the height of the head. Feet strong; tarsi very short or of moderate length. Plumage rather dense; facial disks, incomplete above. Wings very large, the third quill longest, the first with the filaments thickened, and a little free, but scarcely recurved at the end. Tail varying in length. (Audubon Syn, page 21.)

Audubon in his synopsis recognises in the family STRIGIDAE, (the owls) siæ genera, SURNIA the day owl; ULULA, the Night owl; STRIÆ, the Screech owl; SYRNIUM, the Hooting owl; OTUS, the

Eared owl; and BUBO, the Horned owl. There are four species of the first genus, and they, unlike others of the family, hunt by day as well as by night. The largest species and the one most common in Canada is the following:

THE SNOWY DAY OWL.

Surnia Nyctea.—(Linn).

In this magnificent species, the head is small in proportion to the size of the body; the bill almost entirely hidden by the hairy feathers at its base; plumage snow white, but mor or less variegated with transverse brown spots or stripes; the younger the bird is the longer and more numerous are those spots and stripes; very old individuals are pure white, without any brown spot; the feet are covered with fine hair-like feathers so that each seems buried in a lock of coarse wool, the claws only peeping through. The length of the male is about 21 inches, spread of wings 53; female 26 65.

This is a northern species, the geographical range being extended quite into the arctic circle, and according to many good ornithologists, it is identical with the bird bearing the same name which is found in all the polar regions of the old world. It is called by the Crees, Wapow-keetho or Wapohoo, and by the Esquimaux, Oopeeguak. It hunts during the day as well as in the dusky light of the morning and evening, feeding upon hares, squirrels, mice, fishes and birds. Audubon found in the stomach of one specimen, the whole of a large rat in pieces of considerable size, the head and tail being almost entire, the same Naturalist saw some of these birds catching fish; they invariably laid down flat upon the rock with the body placed lengthwise along the border of the hole, the head also laid down but turned towards the water, one might have supposed the bird sound asleep, as it would remain in the same position until a good opportunity of securing a fish occurred, which was never missed; for as the latter unwittingly rose to the surface, near the edge, the owl thrust out the foot next the water, and with the quickness of lightning, seized it and drew it out. The owl then removed to the distance of a few yards, devoured his prey, and returned to the same hole; or, if it had not perceived any more fish, flew only a few yards over the many holes, marked one, and alighted at a little distance from it. It then squatted, moved slowly towards the edge, and lay as before, watching for an opportunity, whenever a fish of any size was hooked, the owl struck the other foot also into it, and flew off with it to a considerable distance. In tried instances of this kind, the bird carried its prey across the river into the woods as if to be quite out of harm's way, there was no note uttered on these occasions; even when two birds joined they ate in silence.

The hunters sometimes find that the musk rats caught in their traps have been devoured. One of them placed some traps with musk rats for bait, and was rewarded with the sight of one or more Snowy Owls each morning, until the thieves as he called them, were pretty well exterminated.

The flight of this bird is firm and long sustained, although smooth and perfectly noiseless. It passes swiftly over its hunting ground, seizes its prey by instantaneously falling upon it, and generally devours it upon the spot. When the objects of its pursuit are on the wing, such as ducks, geese, or pigeons, it gains upon them by urging its speed, and strikes them somewhat in the manner of the Peregrine Falcon. It is fond of the neighbourhood of rivers and small streams, having in their course cataracts or shallow rapids, on the borders of which it seizes on fishes in the manner above mentioned.

This species is somewhat common in Canada, and specimens of it may be seen in almost every collection of stuffed birds. It occurs in Nova Scotia, New Brunswick, and all the Northern States, but does not descend, except occasionally, to the southern part of the Union. In Lapland it is said, they are shot with a ball while hunting after moles and lemmings. Sometimes when the sportsman has shot a grouse, the Snow Owl sails quietly down and bears it away before the lawful owner can secure his prize. Sir John Richardson says it frequents most of the Arctic lands that have been visited, but retires with the Ptarmigan, on which it preys, to more sheltered districts in winter. When I have seen it, says this author, on the barren grounds, it was generally squatting on the earth; and if put up, it alighted again after a short flight, but was always so wary as to be approached with difficulty. In woody districts it shews less caution. I have seen it pursue the American hare on the wing, making repeated strokes at the animal with its feet. In winter, when this Owl is fat, the Indians and white residents in the Fur countries esteem it to be good eating. Its flesh is delicately white." Wilson says from all the specimens he has examined, he is of opinion that the male only becomes pure white with age, the female never.

Its habits during the breeding season, such as the construction of its nest, period of incubation, &c., do not appear to be well known.

ARTICLE. LX.—*The Enemies of the Wheat Fly.*

The life of an insect consists of several stages. The parent fly lays an egg, and from that egg is hatched a worm, which after a period of existence more or less extended, according to the species, makes a sort of retrograde step, if we may so speak, in the journey of vitality and becomes a thing, which often more resembles an egg than the perfect insect intended to be finally produced. In this, *the pupa* state, the little animal is neatly enveloped in a membraneous shell, and remains for a time without sustenance or motion, but all the time undergoing a natural process, whereby in the end the gaudy butterfly, the hard-winged beetle, or the terrible wheat fly, is slowly but surely elaborated : and each of these again, after enjoying the sweets of insect life for a while, lays its egg and dies ; thus completing the circle.

There is more than this, however, to excite our admiration. As in most instances the parent dies before its young is hatched, and as with many species the larva, immediately upon its exit from the egg, requires a particular kind of food, without a supply of which it must inevitably perish ; there can be little doubt but that if this be not previously provided, the series of events would be abruptly broken off by the death from starvation of the new born insect.

In these cases where the mother can never see her progeny, how is she to know what kind of food it will require ? We do not yet know enough of nature to answer that question. Of this much only we are quite certain. The parent always seeks out a mass of provision of the proper sustenance, and lays her egg either in or near it, so that when the latter is hatched, the little helpless worm that comes forth, has only to open its mouth and eat. Thus the Hessian Fly deposits her egg on the blade of the wheat plant, perhaps the only plant whose juices will nourish her young, making this selection she is guided by some pre-real, the nature of which is as yet unknown to the most profound metaphysicians. And when the larva comes forth, guided by another instinct, it immediately scrambles away straight down the stalk until it arrives at the joint, where it becomes fixed, and is nourished by the vegetable fluids that otherwise would have invigorated the plant. The *wheat midge*, a second species, selects the flower as it is only on the grain that her future progeny can subsist. And she so manages with respect to the time, that just at the moment when her young ones are sufficiently advanced to require food, the grain of wheat is sufficiently grown to feed them.

With these two species, the larvæ subsist upon vegetable food, but there are others whose organization is such, that they can only live upon animal substances. Consequently such are sought out by the parent; one kind selecting a dead and another a living animal in which to deposit the egg. Others construct a nest, lay the egg, then sally forth, kill some other insect and place the carcass in the nest, where it will be ready for the larva to feed upon as soon as the shell is broken.

It is said by ornothologists, that certain birds too indolent to construct nests of their own, leave their eggs in those of other species, where they are hatched by the unwittingly bestowed warmth of the strangers. Insects are still more unprincipled. The *Ichneumon* actually waits until the wheat midge has laid her egg and until the larva is hatched, when she seizes upon the youthful destroyer of the staff of life, bores a hole through his skin and deposits her egg in the soft parts of his body. The young wheat midge is thus compelled much against his will it appears to become a sort of external step mother to the young *Ichneumon*, who is hatched inside, and immediately devours his foster parent.

In was for this reason that the *Ichneumon* was supposed, at one time, to be the insect that injured the wheat, because they were seen to come out of the empty pupa cases of the wheat fly, when in fact, instead of being injurious it is the most important protector, as its own existence depends upon the destruction of the species which really effects the damage.

We do not know that the two species of insects described in what follows occur in this country, but as everything bearing upon the principle subject, that of the natural history of insects injurious to our crops is of importance, we think it will be useful to publish the account of them given in the Journal of the Royal Agricultural Society *of England*, *Vol.* 6, by John Curtis, f. l. s.

Referring to the *Ichneumon* this author says:

" This insect is found upon grasses as early as June, and on the glumes of the wheat in July and August, when it runs over the ears and searches out the infected ones, depositing a single egg in each of the larvæ by means of its sharp tail. The late Mr. A. Mathews, before he left England, sent me specimens, informing me that he had found them in the greatest abundance in the glumes of the wheat in a field near Sittingbourne, Kent, the beginning of July. Never having seen this *Ichneumon* depositing its eggs, I cannot satisfy the curiosity of the reader better than by transcribing Mr. Kirby's graphic account of its operations. "To see our little *Ichneumon*," says Mr. Kirby, "deposit its egg in the caterpillar of the wheat-fly is a very entertaining sight. In order to enjoy this pleasure I placed a number of the latter upon a sheet of white paper, at no great distance from each other, and then set an *Ichneumon* down in the midst of them. She began immediately to march about, vibrating her antennæ very briskly; a larva was soon discovered, upon which she fixed herself, the vibratory motion of her antennæ increasing to an intense degree: then bending her body obliquely under her breast, she applied her anus to the larva, and during the insertion of her *aculeus* and the depositing of the egg her antennæ became perfectly still and motionless. Whilst this operation was performing, the larva appeared to feel a momentary sensation of pain, for it gave a violent wriggle. When all was finished, the little *Ichneumon* marched off to seek for a second, which was obliged to undergo the same operation, and so on to as many as it could find in which no egg had been before deposited, for it commits only a single egg to each larva. I have seen it frequently mount one which had been pricked before, but it soon discovered its mistake and left it. The size of it is so near that of the *Tipula*, that I imagine the larva of the latter could not support more than one of the former, and, therefore, instinct directs it to deposit only a single egg in each; besides, by this means one *Ichneumon* will destroy an infinite number of larvæ."

"These parasites are all included in the Order HYMENOPTERA, and the Family ICHNEUMONIDES ADSCITI; the species I am about to describe is comprised in the Genus PLATYGASTER;* it has been

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* So named from some of the larger ones having broad bodies.

named by Mr. Kirby *Ichneumon Tipulæ*, and is now described as the—

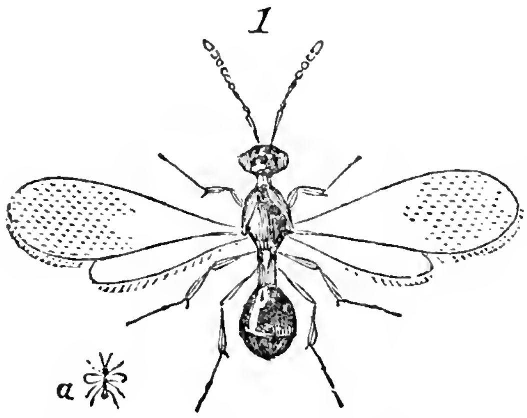

Fig. 1. *Platygaster Tipulæ.*

1. P. Tipulæ. fig. 1; *a*, the natural size. — *Female* pitch-coloured, shining: antennæ nearly as long as the body, inserted at the lower part of the face, slender, clavate, geniculated or angulated; as if broken, slightly pubescent; ochreous, and ten jointed, the four terminal joints brown and obovate, the apical one conical; basal joint long, curved, and clavate; second and third subovate, the latter very slender; fourth a little longer; fifth and sixth minute (fig. *b*); head black, subglobose, thickly and finely punctured, with a minute tooth between the base of the antennæ; eyes oval and lateral, ocelli large and placed nearly in a straight line across the crown; thorax somewhat globose with minute pale pubescence; scutellum horizontal, long, conical, and mucronated; the spine ferruginous; abdomen small, scarcely larger than the thorax; slightly depressed, obovate, black and very shining, attached by a short stout pedicel which is ferruginous at the base; the second segment forms a convex shield, which nearly covers the back, with three or four rings towards the apex; the flexible tip is armed with a very long curved ovipositor, like a hair, which is concealed in the abdomen when at rest: the four wings transparent, iridescent, pubescent, and ciliated, destitute of nervures, the superior much the largest, the apex quite round: leg strong, bright ochreous; thighs thickened at their extremities; tibiæ spurred at the apex, very clavate, hinder with the knob sometimes fuscous; tarsi slender and five-jointed. "*Male* black, shining, very smooth, sparingly clothed with short pubescence: head excessively finely punctured, slightly shining: eyes and ocelli pitchy black: antennæ pitchy, first to fifth joints reddish: apex of scutellum fuscous; metathorax and first abdominal segment rough, obscure, pilose: abdomen smooth, shining; second segment with two little pits at the base; legs pale reddish; hinder tibiæ and apex of tarsi pitchy: wings somewhat transparent: scales pitchy."

"It seems that the males do not differ, except in a trifling degree, in the structure of the horns, in which, I believe, the fourth joint is larger and the tenth longer and more pointed: but it is very remarkable that whilst the females occasionally swarm, so little is known of the habits of the opposite sex that I have not yet been able to meet with a specimen. The only one I ever saw was captured by Mr. Haliday on a rose-tree, and the above characters are translated from Mr. F. Walker's paper upon the Genus *Platygaster.** This is such an extensive group that he has described 99 species which inhabit this country, and amongst them is one named *P. Tritici* by Mr. Haliday, who found it on corn and willows in England and Ireland, and from its specific name it is evident that talented naturalist considered it to be connected with our wheatfields.†

"The second species described by Mr. Kirby he has named ICHNEUMON INSERENS; it is apparently a PLATYGASTER; ‡but as I have not been able to find the specimen in his collection, I must be satisfied in transcribing his account and copying his figures. He says, "Upon the 7th of June I observed a very minute *Ichneumon* exceedingly busy upon the ears of wheat, which, at first, I took for *Ichneumon Tipulæ;* but upon a closer examination I found it to be a species entirely distinct, as will appear when I come to describe it. As soon as I was convinced of this, and observed that it pierced the florets at a time when no larvæ had made their appearance, I conjectured that it must lay its eggs in the eggs of the *Tipula*." "This insect is furnished with an *aculeus* three or four times its own length (fig. *c*), which is finer than a hair and nearly as flexile; this is commonly concealed within the abdomen, but when the animal is engaged in laying its eggs it is exserted; one day it gave me a full opportunity of examining this process. It inserts its aculeus between the valvules of the corolla near the top of the floret; its antennæ are then nearly doubled and motionless, its thorax is elevated, and its head and abdomen depressed; the latter, when it withdraws the *aculeus*, is moved frequently from side to side before it can extricate it. This insect has allowed me to examine its operations under a lens for six or seven minutes: upon opening the floret into which it had

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* Entomological Mag., vol. iii, p. 220.

† Curtis's Brit. Ent., fol. 309; and Guide, Genus 585, where 108 species are recorded.

‡ I have included it in the Genus *Inostemma* in the 'Guide', a Genus which has been formed out of *Platygaster;* but whether I have been right in its location, I am unable at present to determine for want of materials.

introduced its aculeus, I could find neither egg nor larva of the *Tipula*; but, upon examining it very closely under three glasses, I discovered, scattered over one of the valvules of the corolla, a number of globular eggs extremely minute, evidently not those of that insect. It is possible that there were in this floret eggs of the latter, which might be destroyed upon opening it, or escape my observation. At other times I have found eggs of the *Tipula Tritici*, and once some larvæ, in florets upon which I had observed this *Ichneumon* busy." "From the time in which it first makes its appearance, ten days before the hatching of the first larvæ, I I am inclined to adopt my original conjecture, that the eggs are its prey; and yet there seems not to be a sufficient disproportion between the size of the one and the other for this purpose; at least, it must take more than one to nourish a larva of the *Ichneumon* to its proper size.*

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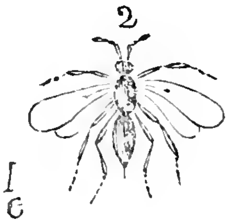

2. *Platygaster inserens.*

"2. Platygaster? inserens. *Kirby.* Very black; antennæ clubbed; abdomen lance-shaped, shining:"† fig. 2; *e*, the natural size.—*Female*, body very black; antennæ bent, as if broken, and clubbed; basal joint long, stout, rigid, and clavate, reverse heart-shaped, cleft at the apex viewed laterally; second joint stout, oval, 4 following globular and extremely minute, the remainder forming a compact ovate conic club of 4 joints (fig. *d*): head and thorax somewhat dull in surface: abdomen sessile, lanceolate, excessively black and glossy, very acute, furnished with a very long flexile slender ovipositor, which is exserted (fig. *c*); wings transparent, nerveless, longer than the body; superior with a black line leading from the base towards the middle terminated by a black dot: legs blackish; thighs deep black, somewhat clavate; length less than a line.

"The third parasite detected by Mr. Kirby appeared on the same day that the *Platygaster Tipulæ* came forth in great numbers. He states that, "on the 22nd of June, I observed another *Ichneumon* not uncommon, piercing the florets of the wheat (fig. 3 and 4). This species did not appear to insert its *aculeus* between the valvules of the corolla, but to pierce the glumes of the calyx, to effect which purpose it is armed with a very short one subexserted: of this I found both the sexes; the male was distinguished

* Trans. Linn. Soc., vol. v. p. 102.

† Trans. Linn. Soc., vol. v. p. 107.

from the female by its large eyes, placed very near each other, with reticulations unusually visible. I presume this to lay its eggs in the larvæ, but have not been able positively to ascertain the fact.*

"This singular species has been characterised as the Genus MACROGLENES by Mr. Westwood, and I am happy in being able to give drawings from nature of the sexes, as the figure in the Linnæan Transactions is not sufficiently correct to identify it.† Mr. Westwood, however, has examined Mr. Kirby's original specimen of *Ichneumon penetrans*, and informs me that it is identical with his Genus *Macroglenes*, which is comprised in the Family CHALCIDIDAE, a parasitic group of immense extent as to amount of species, and scarcely yielding in numbers to any of the insect tribes as to aggregate masses. I have already described and figured several species of *Chalcididæ*; they frequently inhabit and feed upon the parasitic larvæ of *Hymenoptera*, to keep them within due bounds.

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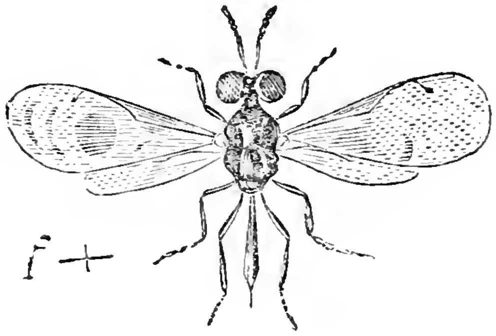

Male.

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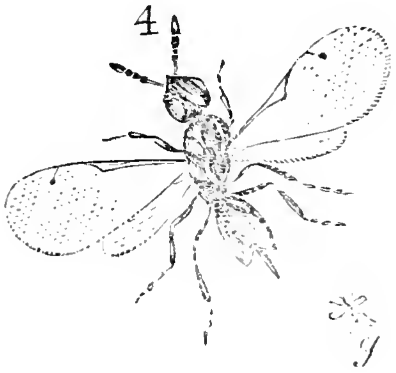

Female.

"3. Macroglenes penetrans.—The *male* is dark blue-green, sometimes slightly tinged with violet, shining; antennæ not so long as the head and thorax, geniculated and clavate, ten-jointed, basal joint long; second as stout, oval; three following very minute and saucer-shaped; sixth and seventh stout, cup-shaped; the remainder forming a compact black ovate-conic club: head large and transverse, face orbicular, including the eyes, which are very large, lateral, reddish brown, orbicular, coarsely reticulated and approaching each other on the crown, ocelli 3, forming a long triangle, prominent and larger than usual, especially the apical one: thorax oval, as broad as the head; the sutures deep, forming

* Trans. Linn. Soc., p. 104.

† Mr. Haliday presented me with a male; for the loan of the other sex I am indebted to Mr. F. Walker.

4 very convex protuberances; abdomen very much compressed, not longer than the thorax, and somewhat elliptical viewed laterally, with six distinct segments, and a short exserted slender process at the apex: wings ample, very transparent, iridescent; superior with a subcostal nervature reaching nearly to the middle, where it unites with the costa, and a little beyond it forms a short branch, terminated by a minute dot: legs simple and slender; tarsi five-jointed, dirty white, darker at the tips (fig. 3; *f*, the natural size); length three-fourths of a line, expanse one and two-thirds of a line. The *female* is scarcely so large, and differs, I think, in having shorter antennæ, with a more abrupt club; the face is very concave, forming a broad deep groove: the 3 ocelli are placed in a transverse line at the back of the crown: the eyes are not large, but brown, oval, and remote: the abdomen is very much compressed, the back forming a sharp edge, and it is very deep viewed laterally, the apex is truncated, and an oviduct enclosed between two valves projects beyond it; fig. 4; *g*, the natural size."*

ARTICLE XLI.—*Natural History, from "Glaucus, or the Wonders of the Shore."* †

I have said, that there were excuses for the old contempt of the study of Natural History. I have said, too, it may be hoped, enough to show that contempt to be now ill-founded. But still there are those who regard it as a mere amusement, and that as a somewhat effeminate one; and think that it can at best help to while away a leisure hour harmlessly, and perhaps usefully, as a substitute for coarser sports, or for the reading of novels. Those, however, who have followed it out, especially on the sea-shore, know better. They can tell from experience that over and above its accessory charms of pure sea-breezes, and wild rambles by cliff and loch, the study itself has had a weighty moral effect upon their hearts and spirits. There are those who can well understand how the good and wise John Ellis, amid all his philanthropic labors for the good of the West Indies, while he was spending his

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* Mr. Haliday has described two more species of this genus in vol. iii. of the Trans. of the Ent. Soc., p. 295; he found all of them in various wild flowers.

† Glaucus, or the Wonders of the Shore, by Charles Kingsley, author of "Amyas Leigh," "Hypatia," &c. American edition; Boston, *Ticknor and Fields*, 1855.

intellect and fortune in introducing into our tropic settlements the bread-fruit, the mangosteen, and every plant and seed which he hoped might be useful for medicine, agriculture, and commerce, could yet feel himself justified in devoting large portions of his ever well-spent time to the fighting the battle of the corallines against Parsons and the rest, and even in measuring pens with Linné, the prince of naturalists. There are those who can sympathize with the gallant old Scotch officer mentioned by some writer on sea-weeds, who, desperately wounded in the breach at Badajos, and a sharer in all the toils and triumphs of the Peninsular war, could in his old age show a rare sea-weed with as much triumph as his well-earned medals, and talk over a tiny spore-capsule with as much zest as the records of sieges and battles. Why not? That temper which made him a good soldier may very well have made him a good naturalist also. And certainly, the best naturalist, as far as logical acumen, as well as earnest research, is concerned, whom England has ever seen, was the Devonshire squire, Colonel George Montagu, of whom Mr. E. Forbes * well says, that "had he been educated a physiologist," (and not, as he was, a soldier and a sportsman,) "and made the study of nature his aim and not his amusement, his would have been one of the greatest names in the whole range of British science." I question, nevertheless, whether he would not have lost more than he would have gained by a different training. It might have made him a more learned systematizer; but would it have quickened in him that "seeing eye" of the true soldier and sportsman, which makes Montagu's descriptions indelible word-pictures, instinct with life and truth? "There is no question," says Mr. E. Forbes, after bewailing the vagueness of most naturalists, "about the identity of any animal Montagu described. . . . . He was a forward-looking philosopher; he spoke of every creature as if one exceeding like it; yet different from it, would be washed up by the waves next tide. Consequently his descriptions are permanent." Scientific men will recognize in this the highest praise which can be bestowed, because it attributes to him that highest faculty,—*The Art of Seeing:* but the study and the book would not have given that. It is God's gift, wheresoever educated; but its true school-room is

* "British Star-fishes." This delightful writer, and eager investigator, has just died, in the prime of life, from disease contracted (it is said) during a scientific journey in Asia Minor: one more martyr to the knight-errantry of science.

the camp and the ocean, the prairie and the forest; active self-helping life, which can grapple with Nature herself, not merely with printed books about her. Let no one think that this same Natural History is a pursuit fitted only for effeminate or pedantic men. We should say rather that the qualifications required for a perfect naturalist are as many and as lofty as were required by old chivalrous writers, for the perfect knight-errant of the Middle Ages; for (to sketch an ideal, of which we are happy to say our race now affords many a fair realization) our perfect naturalist should be strong in body; able to haul a dredge, climb a rock, turn a boulder, walk all day, uncertain where he shall eat or rest; ready to face sun and rain, wind and frost, and to eat or drink thankfully anything, however coarse or meagre; he should know how to swim for his life, to pull an oar, sail a boat, and ride the first horse which comes to hand; and, finally, he should be a thoroughly good shot, and a skilful fisherman; and, if he go far abroad, be able on occasion to fight for his life.

For his moral character, he must, like a knight of old, be first of all gentle and courteous, ready and able to ingratiate himself with the poor, the ignorant, and the savage; not only because foreign travel will be often otherwise impossible, but because he knows how much invaluable local information can be only obtained from fishermen, miners, hunters, and tillers of the soil. Next he should be brave and enterprising, and withal patient and undaunted; not merely in travel, but in investigation; knowing (as Lord Bacon might have put it) that the kingdom of Nature, like the kingdom of heaven, must not be taken by violence, and that only to those who knock long and earnestly does the great mother open the doors of her sanctuary. He must be of a reverent turn of mind also, not rashly discrediting reports, however vague and fragmentary; giving man credit always for some germ of truth, and giving nature credit for an inexhaustible fertility and variety, which will keep him his life long always reverent, yet never superstitious; wondering at the commonest, but not surprised by the most strange; free from the idols of size and sensuous loveliness; able to see grandeur in the minutest objects, beauty in the most ungainly; estimating each thing not carnally, as the vulgar do, by its size or its pleasantness to the senses, but spiritually, by the amount of Divine thought revealed to him therein; holding every phenomenon worth the noting down; believing that every pebble holds a treasure, every bud a revelation; making it a point of conscience to pass over nothing through laziness or hastiness, lest the vision once offered and despised should be withdrawn; and looking at every object as if he were never to behold it again.

Moreover, he must keep himself free from all those perturbations of mind which not only weaken energy, but darken and confuse the inductive faculty; from haste and laziness, from melancholy, testiness, pride, and all the passions which make men see only what they wish to see. Of solemn and scrupulous reverence for truth, of the habit of mind which regards each fact and discovery not as our own possession, but as the possession of its Creator, independent of us, our tastes, our needs, or our vain-glory, we hardly need to speak; for it is the very essence of a naturalist's faculty, the very tenure of his existence; and without truthfulness science would be as impossible now as chivalry would have been of old.

And last, but not least, the perfect naturalist should have in him the very essence of true chivalry, namely, self-devotion; the desire to advance, not himself and his own fame or wealth, but knowledge and mankind. He should have this great virtue; and in spite of many short-comings, (for what man is there who liveth and sinneth not?) naturalists as a class have it, to a degree which makes them stand out most honorably in the midst of a self-seeking and mammonite generation, inclined to value everything by its money price, its private utility. The spirit which gives freely, because it knows that it has received freely; which communicates knowledge without hope of reward, without jealousy and mean rivalry, to fellow-students and to the world; which is content to delve and toil comparatively unknown, that from its obscure and seemingly worthless results others may derive pleasure, and even build up great fortunes, and change the very face of cities and lands, by the practical use of some stray talisman which the poor student has invented in his laboratory;—this is the spirit which is abroad among our scientific men, to a greater degree than it ever has been among any body of men, for many a century past; and might well be copied by those who profess deeper purposes, and a more exalted calling, than the discovery of a new zoophyte, or the classification of a moorland crag.

And it is these qualities, however imperfectly they may be realized in any individual instance, which make our scientific men, as a class, the wholesomest and pleasantest of companions abroad, and at home the most blameless, simple, and cheerful, in all domestic relations; men for the most part of manful heads, and yet of childlike hearts, who have turned to quiet study, in these late piping times of peace, an intellectual health and courage which might have made them, in more fierce and troublous times, capable of doing good service with very different instruments than the scalpel and the microscope.

I have been sketching an ideal: but one which I seriously recommend to the consideration of all parents; for, though it be impossible and absurd to wish that every young man should grow up a naturalist by profession, yet this age offers no more wholesome training, both moral and intellectual, than that which is given by instilling into the young an early taste for out-door physical science. The education of our children is now more than ever a puzzling problem, if by education we mean the development of the whole humanity, not merely of some arbitrarily chosen part of it. How to feed the imagination with wholesome food, and teach it to despise French novels, and that sugared slough of sentimental poetry, in comparison with which the old fairy-tales and ballads were manful and rational; how to counteract the tendency to shallow and conceited sciolism, engendered by hearing popular lectures on all manner of subjects; which can only be really learnt by stern methodic study; how to give habits of enterprise, patience, accurate observation, which the counting-house or the library will never bestow; above all, how to develope the physical powers, without engendering brutality and coarseness,—are questions becoming daily more and more puzzling, while they need daily more and more to be solved, in an age of enterprise, travel, and emigration, like the present. For the truth must be told, that the great majority of men, who are now distinguished by commercial success, have had a training the directly opposite to that which they are giving to their sons. They are, for the most part, men who have migrated from the country to the town, and had in their youth all the advantages of a sturdy and manful hill-side or sea-side training; men whose bodies were developed, and their lungs fed on pure breezes, long before they brought to work in the city the bodily and mental strength which they had gained by loch and moor. But it is not so with their sons. Their business habits are learnt in the counting-house; a good school, doubtless, as far as it goes; but one which will expand none but the lowest intellectual faculties; which will make them accurate accountants, shrewd computers and competitors, but never the originators of daring schemes, men able and willing to go forth to replenish the earth and subdue it. And in the hours of relaxation, how much of their time is thrown away, for want of anything better, on frivolity, not to say on secret profligacy, parents know too well; and often shut their eyes in very despair to evils which they know not how to cure. A frightful majority of our middle-class young men are growing up effeminate, empty of all knowledge but what tends directly to the making of a fortune; or rather, to speak correctly, to the keeping up the fortunes which their fathers have made for them; while of the minority, who are indeed thinkers and readers, how many women as well as men have we seen wearying their souls with study undirected, often misdirected; craving to learn, yet not knowing how or what to learn; cultivating, with unwholesome energy, the head at the expense of the body and the heart; catching up with the most capricious self-will one mania after another, and tossing it away again for some new phantom; gorging the memory with facts which no one has taught them to arrange, and the reason with problems which they have no method for solving; till they fret themselves into a chronic fever of the brain, which too often urges them on to plunge, as it were to cool the inward fire, into the ever-restless sea of doubt and disbelief. It is a sad picture. There are many who may read these pages whose hearts will tell them that it is a true one. What is wanted in these cases is a methodic and scientific habit of mind; and a class of objects on which to exercise that habit, which will fever neither the speculative intellect nor the moral sense; and those physical science will give, as nothing else can give it.

Moreover, to revert to another point which we touched just now, man has a body as well as a mind; and with the vast majority there will be no *mens sana* unless there be a *corpus sanum* for it to inhabit. And what out-door training to give our youths is, as we have already said, more than ever puzzling. The difficulty is felt, perhaps, less in Scotland than in England. The Scotch climate compels hardiness; the Scotch bodily strength makes it easy; and Scotland, with her mountain-tours in summer, and her frozen lochs in winter, her labyrinth of sea-shore, and, above all, that priceless boon which Providence has bestowed on her, in the contiguity of her great cities to the loveliest scenery, and hills where every breeze is health, affords facilities for healthy physical life unknown to the Englishman, who has no Arthur's Seat towering above his London, no Western Islands spotting the ocean firths beside his Manchester. Field sports, with the invaluable training which they give, if not

> "The reason firm,"

yet still

> "The temperate will,
> Endurance, foresight, strength, and skill,"

have become impossible for the greater number; and athletic exercises are now, in England at least, so artificialized, so expensive, so mixed up with drinking, gambling, and other evils of which we need say nothing here, that one cannot wonder at any parents' shrinking from allowing their sons to meddle much with them. And yet the young man who has had no substitute for such amusements will cut a very sorry figure in Australia, Canada, or India; and, if he stays at home, will spend many a pound in doctors' bills, which could have been better employed elsewhere. "Taking a walk" as one would take a pill or a draught, seems likely soon to become the only form of out-door existence possible for us of the British Isles. But a walk without an object, unless in the most lovely and novel of scenery, is a poor exercise, and as a recreation utterly nil. We never knew two young lads go out for a "constitutional," who did not, if they were commonplace youths, gossip the whole way about things better left unspoken; or, if they were clever ones, fall on arguing and brainsbeating on politics or metaphysics from the moment they left the door, and return with their wits even more heated and tired than they were when they set out. We cannot help fancying that Milton made a mistake in a certain celebrated passage; and that it was not "sitting on a hill apart," but tramping four miles out and four miles in along a turn-pike road, that his hapless spirits discoursed

> "Of fate, free-will, foreknowledge absolute,
> And found no end, in wandering mazes lost."

Seriously, if we wish rural walks to do our children any good, we must give them a love for rural sights, an object in every walk; we must teach them—and we can teach them—to find wonder in every insect, sublimity in every hedgerow, the records of past worlds in every pebble, and boundless fertility upon the barren shore; and so, by teaching them to make full use of that limited sphere in which they now are, make them faithful in a few things, that they may be fit hereafter to be rulers over much.

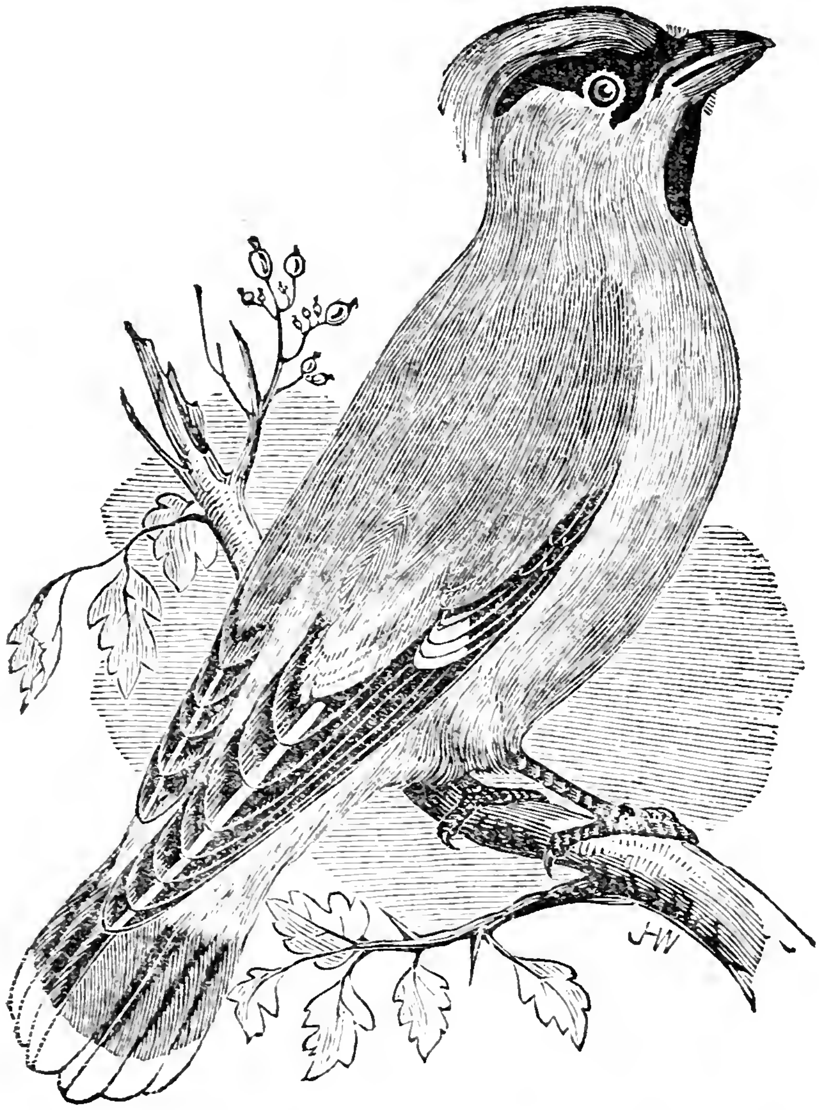
I may seem to exaggerate the advantages of such studies; but the question after all is one of experience; and I have had experience enough and to spare that what I say is true. I have seen the young man of fierce passions, and uncontrollable daring, expend healthily that energy which threatened daily to plunge him into recklessness, if not into sin, upon hunting out and collecting, through rock and bog, snow and tempest, every bird and egg of the neighboring forest. I have seen the cultivated man, craving for travel and for success in life, pent up in the drudgery of London work, and yet keeping his spirit calm, and perhaps his morals all the more righteous, by spending over his microscope evenings which would too probably have gradually been wasted at the theatre. I have seen the young London beauty, amid all the excitement and temptation of luxury and flattery, with her heart pure and her mind occupied in a boudoir full of shells and fossils, flowers and sea-weeds, and keeping herself unspotted from the world, by considering the lilies of the field, how they grow. And therefore it is that I hail with thankfulness every fresh book of Natural History, as a fresh boon to the young, a fresh help to those who have to educate them.

LAWRENCIAN FORMATION.—This formation was so called by M. Desor, a French Geologist, but as the name has the same sound as Laurention it is not we believe intended to be adopted permanently in this country. Were there no other reason the impossibility of understanding in conversation which of the two might be the subject would of itself be sufficient. But it is not satisfactorily proved as we have before remarked, (337,) that the deposit is distinct from the drift properly so called, and the time therefore has not yet arrived for effecting a separation. It was for this reason that we stated that the Tertiary rocks " are supposed to consist of two divisions." We do not approve of minute subdivisions particularly where as in this case the separation is proposed partly upon negative evidence, i. e., that fossils have not been found in the lower part of the deposit. Several lines of this kind have been already drawn in the geology of North America, and as might be expected are fast fading away before the increasing light of science.

ARTICLE XLII. Notice *of the Occurrence of the Pine Grosbeak and Bohemian Chatterer, near Montreal:* BY W. S. M. D'URBAN, ESQ.

During the severe weather at the beginning of this month I met with a large flock of Pine Grosbeaks, (*Pyrrhula enucleator.* Selby,) and Bohemian Waxwings, or Chatterers (*Bombycilla-garrula.* Flem.) on the Mountain about half a mile beyond the Priest's Farm. They were feeding in company on the berries of the Mountain Ash, and I succeeded in shooting a male and female of the Grosbeaks, but was not so fortunate as to obtain any of the Chatterers. I have, however, seen several specimens, which were shot, lately, near the "back river" by a Canadian, and now in the possession of Mr. Broome, of the Natural History Society. At first they were quite tame, and allowed me to go close to them, but after I had fired at them, they became much more difficult of approach. I found the Grosbeaks for several successive days feeding in the same place, but the Waxwings disappeared after the second day, and I saw no more of them. The red plumage of the Grosbeaks, and the pointed crests and yellow tipped tails of the Chatterers, rendered it easy to distinguish the two species from each other, even at a considerable distance. It had a pretty effect, on a bitter cold day, the Thermometer being some degrees below Zero, to see these beautiful and hardy birds, picking off the bright-red berries, the Grosbeaks clinging back downwards to the branches, like Parrots. It was also peculiarly interesting to an English Ornithologist, to behold two species deemed such rarities at home, feeding in numbers within a few yards of him. The two specimens I shot, when skinned, had a strong odour of Prussic-acid, derived from the pips of the Mountain Ash berries with which their stomachs were crammed, and their throats were full of the pulp and seeds alone, as they dexterously squeeze out the seeds and pulp, rejecting the skins, which are scattered over the snow, in great quantities under the trees where they feed. There was a considerable amount of orange-coloured fat on their bodies, showing that they throve on the fare they had found. The last time I saw the Pine Grosbeaks, was on the 20th, when I observed the flock flying about over the place where I first met with them, and I believe they still continue in the neighbourhood. As far as I am informed, these two species are rare in this portion of Canada, and I trust this short notice of their occurence here, may not be uninteresting to the Editor of the Canadian Naturalist and Geologist.—*W. S. M. d'Urban, Montreal, 23rd January*, 1857.

NOTE.—The pine Grosbeak according to Wilson's description, "measures nine inches in length and fourteen in extent; the head, neck, breast and rump are of a rich crimson, palest on the breast; the feathers on the middle of the b ck are centred with arrow shaped spots of black, and skirted with crimson, which gives the plumage a considerable flush of red there; those on the shoulders



European Wax-Wing (*Bombycilla garrula*), male.

are of a deep slate colour, partially skirted with red and light ash, The greater wing coverts and next superior row are broadly tipped with white, and slightly tinged with reddish; wings and tail black, edged with light brown; tail considerably forked; lower part of the belly, ash colour; vent feathers skirted with white, and streaked with black; legs glossy black; bill a brownish horn colour, very thick, short and hooked at the point; the upper mandible overhanging the lower considerably, approaching in its form to that of the parrot; base of the bill, covered with recumbent hairs of a dark brown colour. The whole plumage near the roots, as in most other birds, is of a deep bluish ash colour. The female was half an inch shorter, and answered nearly to the above description; only those parts that in the male were crimson were in her of a yellowish colour."

In an interesting paper (on the Land Birds wintering in the neighbourhood of Toronto, by G. W. Allan, Esq.,) read before the Canadian Institute in 1853, it is stated that this species visited the vicinity of that city in 1839, in large flocks. In 1836 they were shot so far south as Philadelphia. It is a constant resident however in the cold regions of the Hudson's Bay territory, and is only seen in the inhabited southern border of Canada in very cold winters.

This bird is said to be a charming songster, Wilson kept one of them in a cage for more than half a year, and he remarkes that in May and June its song, though not so loud as some birds of its size, was extremely clear, mellow and sweet. It would warble out this for a whole morning together, and acquired several notes of the red bird that hung near it.

Bombycilla garrula. This bird very much resembles the common Wax-wing or cedar bird, sometimes also called the cherry bird in this country. From the account which follows it will be seen, however, that this species is different and has a very wide geographical range, being an European as well as an American bird. On this continent it breeds in the northwest, and only visits us in cold winters.

The following description is from the English Cyclopaedia:

B. garrula, European Wax-Wing or Chatterer. This elegant species, which is also known by the English names of the Bohemian Chatterer, Bohemian Wax-Wing and Silk-Tail, is Le Jaseur de Bohême, (Buffon, &c.), Grand Jaseur (Temminck), and Geay de Bohême of the French; Garrulo di Boemia of the Italians; Rothlichgrauer Seidenschwantz (Meyer), Europaischer Seidenschwanz, and Gemeine Seidenschwanz (Bechstein) of the Ge mans; *Garrulus Bohemicus* of Gesner; *Bombycilla* of Schwenck; *Ampelis* of Aldrovand; *Bombycilla Bohemica* of Brisson; *Ampelis garrulus* of Linnæus; *Bombyciphora garrula* of Brehm; *Bombyciphora poliocœlia* of Meyer; *Bombycivora garrula* of Temminck; and *Bombycilla garrula* of Vieillot.

In addition to the nomenclature above given, the bird is said to be named by the Italians in some localities Becco-Frisone, in others, Galletto del Bosco; and by the bird-catchers of Bologna, Uccello del Mondo Novo; by the Germans, Zinzerelle, Wipstertz, Schenee-Vogel and Schenee-Leschke, and by those in the neighbourhood of Nürnberg, Beemerlee and Behemle; by the Swedes, Siden-Swantz; and by the Bohemians, Brkoslaw.

That the Bohemian Chatterer was known to the ancients there can be little doubt; but a great deal of obscurity prevails as to the names by which it was distinguished. Some have taken it to be the *Incendiaria Avis* of Pliny (book x. c. 13), the inauspicious bird, on account of whose appearance Rome more than once underwent lustration, but more especially in the consulship of L. Cassius and C. Marius, when the apparition of a great owl (*Bubo*) was added to the horrors of the year. Others have supposed that it was the bird of the Hercynian forest (book x. c. 47), whose feathers shone in the night like fire. Aldrovandus, who collected the opinions on this point, has taken some pains to show that it could be neither the one nor the other. The worthy Italian gravely assures his readers that its feathers do not shine in the night; for he says he kept one alive for three months, and observed it at all hours ("quâvis noctis horâ contemplatus sum.")

It is by no means improbable that this bird was the gnaphalos of Aristotle ('Hist. Anim.,' book ix. c. 16).

The geographical range of the Bohemian Chatterer is extensive, comprehending a great portion of the arctic world. It appears generally in flocks, and a fatality was at one time believed to accompany their movements. Thus Aldrovandus observes that large flights of them appeared in February, 1530, when Charles V. was crowned at Bologna; and again in 1551, when they spread through the duchies of Modena, Piacenza, and other Italian districts, carefully avoiding that of Ferrara, which was afterwards convulsed by an earthquake. In 1552, according to Gesner, they visited the banks of the Rhine, near Mentz, in such myriads that they darkened the air. In 1571 troops of them were seen flying about the north of Italy, in the month of December, when the Ferrarese earthquake, according to Aldrovandus, took place, and the rivers overflowed their banks.

Necker, in his Memoir on the Birds of Geneva, observes that from the beginning of this century only two considerable flights have been observed in that canton, one in January, 1807, and the other in 1814, when they were very numerous, and having spent the winter there, took their departure in March. In the first of those years they were scattered over a considerable part of Europe, and early in January were seen near Edinburgh. Savi observes that they are not seen in Tuscany except in very severe winters, and that the years 1806 and 1807 were remarkable for the number of them which entered Piedmont, especially the valleys of Lanzo and Suza.

It has been said that it is always rare in France, and that of late years it has become scarce in Italy and Germany; but Bechstein observes that in moderate seasons it is found in great flights in the skirts of the forests throughout the greater part of Germany and Bohemia, and that it is to be seen in Thuringia only in the winter: if the season be mild in very small numbers, the greater portion remaining in the north; if the weather be severe, it advances farther south.

The Bohemian Chatterer must be considered only as an occasional visitant to the British Islands, though Pennant says that they appear only by accident in South Britain, but that about Edinburgh they come annually in February, and feed on the berries of the mountain ash; adding that they also appear as far south as Northumberland, and like the fieldfare make the berries of the white thorn their food; he records the death of one which was killed at Garthmeilio in Denbighshire in a fir-tree during the severe frost of December, 1788. Latham, in a note to this statement, says that the late Mr. Tunstall informed him that in the winter of 1787 many flocks were seen all over the county of York, and that towards the spring a flock of between twenty and thirty were observed within two miles of Wycliffe, his place of residence. Bewick states that in the years 1790, 1791, and 1803 several of them were taken in Northumberland and Durham as early as the month of November. Selby says that in the winter of 1810 large flocks were dispersed through various parts of the kingdom, and that from that period it does not seem to have visited our island till the month of February, 1822, when a few came under his inspection, and several were again observed during the severe storm in the winter of 1823. Montagu says that he received it out of Staffordshire, and that he has known others killed in the more southern counties in the autumn and winter. In Mr. Rennie's edition of the 'Ornithological Dictionary' (1833) it appears that one had been shot in the park of Lord Boringdon at Saltram in Devonshire, and that not less than twenty had been killed in the counties of Suffolk and Norfolk during the last three winters.

Graves says that about Christmas, 1803, a number were shot in the neighbourhood of Camberwell, from one of which, being but slightly wounded, his figure was taken. In 'Loudon's Magazine' it is stated that a fine specimen was shot near Coventry in December, 1830, where it appeared to associate with starlings, and that during the same month of the same year six were killed in the vicinity of Ipswich. The late Mr. W. Thompson records various instances of the occurrence of this bird in Ireland. In the British Islands it more frequently occurs in the north than the south, and Mr. Yarrell states that "the winters of 1787, 1788, 1789, 1790, 1791, 1803, 1810, 1820, 1822, 1828, 1830, 1831, 1834, and 1835, are particularly recorded as having afforded opportunities of obtaining specimens in some one or other of various northern localities."

Although called the Bohemian Wax-Wing, it is not more common in Bohemia than England. In the central and southern parts of the European continent it is only an occasional visitor.

In northern Russia and the extreme north of Norway, according to C. L. Bonaparte, they are seen in great numbers every winter, being observed there earlier than in temperate countries. In northern Asia and Eastern Europe their migrations are tolerably regular. Very numerous flocks pass through Scania in November, and are again seen on their return in the spring.

But the species is not confined to Europe and Asia. "By a singular coincidence," says the Prince of Canino, "whilst we were proclaiming this species as American, it was received by Temminck from Japan, together with a new species, the third known of the genus." He says that his best specimen was shot on the 20th of March, 1825, on the Athabasca River, near the Rocky Mountains; and observes that the species appears to be spread widely, as he had been credibly informed by hunters that "cedar-birds of a large kind" had been shot a little beyond the Mississippi; adding that he is at a loss to conceive why it should never have been observed on this side of the last-mentioned river. Mr. Drummond in the spring of 1826 saw it near the sources of the Athabasca, and Sir John Richardson observed it in the same season at Great Bear Lake in lat. 65°, where a male, of which he gives a description, was shot on the 24th of May of that year. He also says that he observed a large flock of at least three or four hundred on the banks of the Saskatchewan, at Carlton House, early in May, 1827. They alighted in a grove of poplars, settling all on one or two trees, and making a loud twittering noise.

They stayed only about an hour in the morning, and were too shy to allow him to approach within gunshot.

The district where these birds breed is unknown. Bechstein says that it does not build in Germany when wild, but within the Arctic Circle.

Bonaparte gives a very amiable character of the European Wax-Wing in a state of nature, attributing to them a particular sentiment of benevolence, even independent of reciprocal sexual attraction. " Not only," says the Prince, " do the male and female caress and feed each other, but the same proofs of mutual kindness have been observed between individuals of the same sex." Speaking of their habits he says, " They always alight on trees, hopping awkwardly on the ground. Their flight is very rapid: when taking wing they utter a note resembling the syllables zi, zi, ri, but are generally silent notwithstanding the name that has been given them." Bechstein says, "When wild we see it in the spring eating, like thrushes, all sorts of flies and other insects; in autumn and winter, different kinds of berries; and in time of need, the buds and sprouts of the beech, maple, and various fruit-trees." Willoughby states that it feeds upon fruit, especially grapes, of which it is very greedy. " Wherefore it seems to me," he adds, " not without reason, to be called by that name *Ampelis*." Bonaparte makes their food to consist of different kinds of juicy berries, or of insects, observing that they are fond of the berries of the mountain-ash and *Phytolacca*, and that they are extremely greedy of grapes, and also, though in a less degree, of Juniper and laurel-berries, apples, currants, figs, and other fruits. He adds that they drink often, dipping their bills repeatedly.

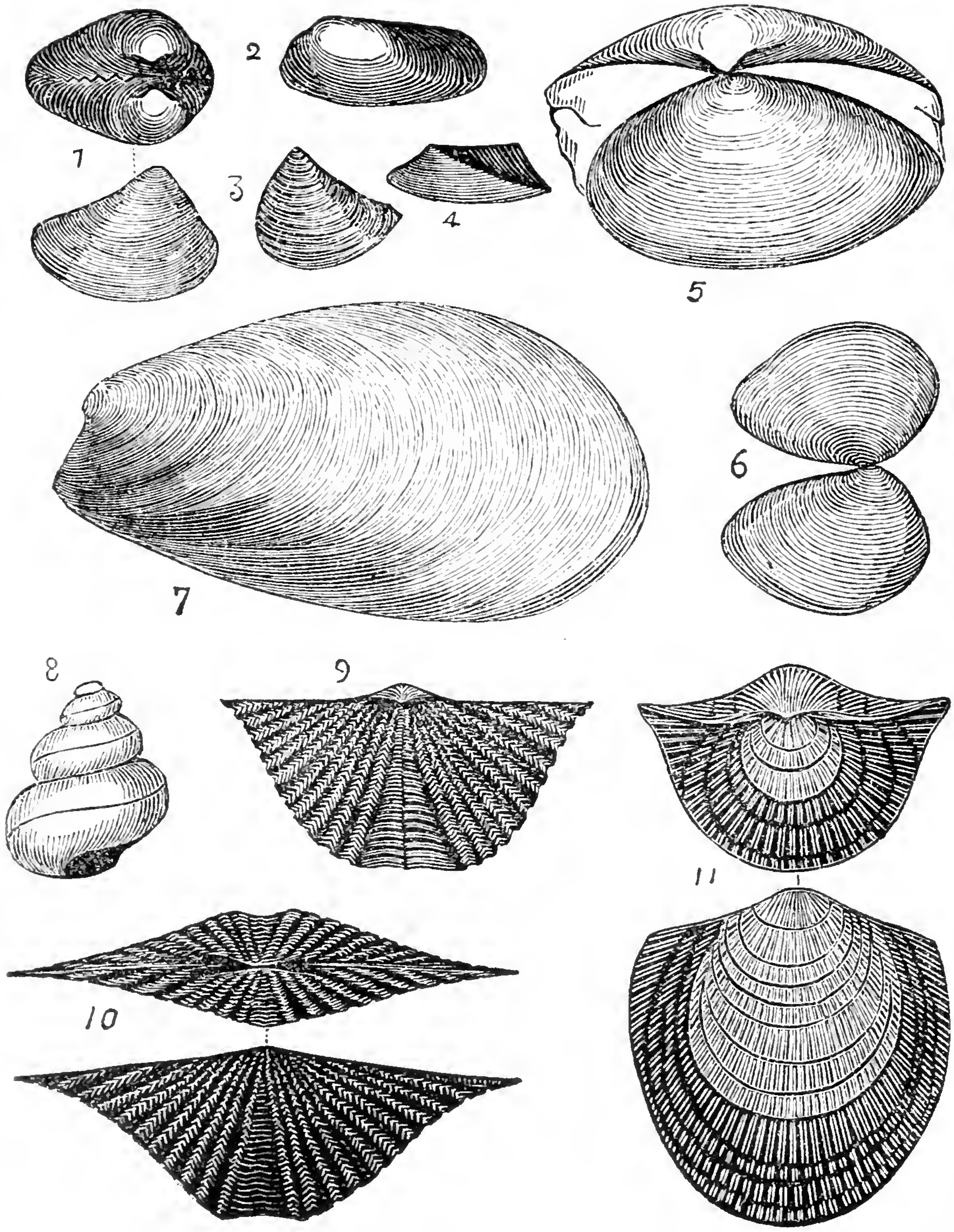
In captivity its qualities do not appear to be very attractive, according to Bechstein, who says that nothing but its beauty and scarcity can render the possession of it desirable, for that it is a stupid and lazy bird. Indeed he draws such a picture of its greediness and dirty habits, that, if it be not overcharged, few we should think would wish to have it as an inmate. Leaving out the more unpleasant parts of his description, we take the following extract from his 'Cage Birds':—" During the ten or twelve years that it can exist in confinement, and on very meagre food, it does nothing but eat and repose for digestion. If hunger induces it to move, its step is awkward, and its jumps so clumsy as to be disagreeable to the eye. Its song consists only of weak and uncertain whistling, a little resembling the thrush, but not so loud. While singing it moves the crest, but hardly moves the throat. If this warbling is somewhat unmusical it has the merit of continuing throughout every season of the year. When angry, which happens sometimes near the common feeding-trough, it knocks very violently with its beak. It is easily tamed." The same author says, that in confinement the two universal pastes appear delicacies to it; and it is even satisfied with bran steeped in water. It swallows everything voraciously, and refuses nothing estable, such as potatoes, cabbage, salad, fruit of all sorts, and especially white bread. It likes to bathe, or rather to sprinkle itself with water, for it does not wet itself so much as other birds.

It is taken in nooses, to which berries are fixed, which for this purpose, says the author last quoted, "should always be kept in store till February. It appears to be frightened at nothing, for it flies into nets and traps, though it sees its companions caught, and hanging and uttering cries of distress and fear."

Length about eight inches; the size altogether approaching that of a starling.

Male. Bill strong, black, except at the base, where the colour inclines to a yellowish-white; nostrils hidden under small black feathers. Irides purplish-red. Chin and throat velvety black, as is also the streak (in the midst of which is the eye) passing from the bill to the hinder part of the head. Fore-head reddish-brown. Head feathers long, silky, forming a reclining crest approaching to reddish-chesnut, which the bird can erect or depress at pleasure. Upper parts purplish-red, or vinaceous-brown dashed with ash-colour, the rump-lightest. Breast and belly pale purplish-ash, tinged with pale brownish-red. Vent and under tail-coverts orange-brown inclining to reddish-orange. Greater wing-coverts black, tipped with white. Lesser wing-coverts of a shade darker than the general tint of the upper plumage. Primaries black, with a bright yellow spot near the white tips of their outer webs. Montagu says that the three first are tipped with white, and the others with yellow on their outer margins. Secondaries gray, tipped with white on the outer web, and seven or eight of them terminated with small flattish, oval, horny appendages, of the colour of red sealing-wax. Sometimes there are not more than 5 or 6 of these wax-like tips, and in Montagu's specimen there were 5 on one side and 6 on the other. Graves gives the nnmber at from 6 to 9 (Bechstein at from 5 to 9,) and mentions the specimen in Mr. Haworth's collection, which had some on the tail, which is black tipped with yellow, and dashed with ash-colour at the base. Shanks, toes, and claws, black.

FOSSILS OF THE HAMILTON GROUP.



1.—*Cucullea opima.*

2.—*Nucula oblonga.*

3.—*Nucula lineata.*

4.—*Cypricardia truncata.*

5.—*Tellina? ovata.*

6.—*Nucula bellatula.*

7.—*Modiola concentrica.*

8.—*Turbo lineatus.*

9 & 10.—*Spirifer mucronatus.*

11.—*Atrypa prisca.*

ARTICLE XLIII.—*Fossils of the Hamilton Group.*

The following description of the fossils represented on the plate, and by the accompanying wood cuts are from the geology of New York, by Professor Hall. Many of them will be found in the western part of Upper Canada, where the Hamilton group occurs.

Fig. 1. *Cucullea opima.* "Ovate, very convex; beaks near the anterior extremity, very prominent; surface marked by strong concentric lines; cast nearly smooth; impression of the internal laminae, oblique. When compressed this fossil has the appearance of a *Nucula*, but the impressions of the internal laminae seem sufficient to warrant its reference to *Cucullea*."

The generic name is from the Latin, *Cucullus*, a hood; the name is probably from *opimus*, fat, or well grown.

Fig 2. *Nucula oblonga.* "Oblong, elliptical, very inequilateral, very finely and concentrically striated; an impressed line extends from the hinge, just forward of the beak, half way to the base."

Generic name from the Latin, *Nucula* a little nut; *Oblongus*, oblong.

Fig. 3. *Nucula lineata.* "Sub-triangular, convex; beak much elevated; surface covered with coarse concentric striæ."

Lineata, covered with lines or striæ.

Fig 4. *Cypricardia truncata* (Conrad.) "Trapezoidal, surface covered with concentric wrinkles; posterior slope sharply carinated. The wrinkles on the posterior slope are parallel to the truncated margin and nearly at right angles with those upon the side of the shell."

The generic name is from the Greek, *Kuprinos*, related to the goddess Venus, and *Kardia*, the heart; *truncata*, latin, truncated or abruptly cut off.

Fig. 5. *Tellina ovata.* "General form ovate, produced posteriorly and apparently slightly gaping at the extremity; posterior slope angulated; surface covered by minute concentric striæ, which become more prominent near the margin."

Generic name from the Greek, *telline*, a sort of mussel, *ovata*, oval or eggshaped.

Fig 6. *Nucula bellatula.* "Ovate, somewhat contracted near the posterior extremity; surface covered with regular, fine concentric striæ; teeth in the hinge margin very distinct; there is a slight depression extending along the posterior slope, giving a contracted appearance to this part of the shell."

The specific name appears to have been derived from the Latin, *bellus*, pretty.

Fig. 7. *Modiola concentrica.* "Oblong-ovate, very inequilateral; surface covered with regular, equal concentric striæ, which become confluent towards the base; hinge line curved; anterior side short, with a longitudinal impression directly below the beaks."

Generic name from the Latin, *modiolus*, a small measure or drinking vessel.

Fig. 8. *Turbo lineatus.* "Turbinate obtuse; surface marked by several sharp spiral lines, all which, except the central one, are not visible on the cast; longitudinally striated, last whorl of the shell rapidly expanding; aperture orbicular; umbilicus moderate."

Turbo Latin, a top, *lineatus*, covered with lines.

Fig. 9 & 10. *Spirifer mucronatus.* "Varying in form from semicircular to triangular, with the hinge line greatly extended; surface marked by 24 to 30 rounded ribs, which are crossed by crowded undulating lamellæ, giving a squamous appearance to the shell hinge; area very narrow; aperture small.

Fig. 9 is the nearly semi-circular form; Fig. 10 shews the hinge line more extended. "This is a very ornamental shell, and its numerous varieties in form are very interesting. In the soft calcareous shales of Western New York, it is shorter and more rotund, while in the sandy shales and shaly sandstones of the middle and eastern part of the State, it is greatly extended, and its extremeties very acute. Occurs in all the localities of the upper middle portion of the group."

Spirifer, from the Latin *spira*, a spire, and *fero*, I bear; *mucronatus*, sharp pointed. This shell occurs abundantly in the formation in western Canada.

Fig. 11. *Atrypa prisca.* "Oblong, often nearly circular; lower valve least convex, with the beak scarcely prominent, and pressed close to the beak of the upper valve; upper valve very convex; front margin often advanced and a little depressed; surface radiated with numerous round striæ, which bifurcate at irregular intervals." "The specimens vary in size, and frequently are flattened from compression, so that they do not present the rotund form of the figure.

Generic name from the Greek *a*, without, and *trupa*, a perforation; *prisca*, old, ancient.

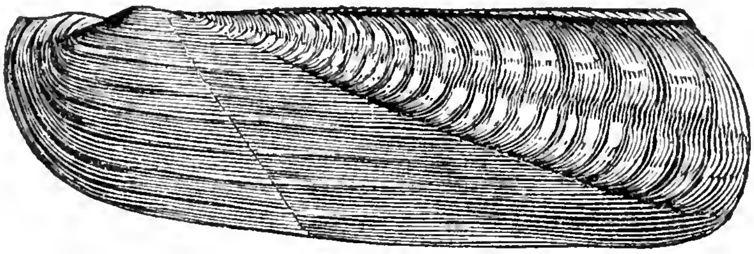


Fig. 12. *Orthonota undulata.*

Fig. 12. *Orthonota undulata.* Professor Hall says this fossil is more common in the eastern part of the State of New York than in the western. It may yet be found in Canada, and therefore we publish it here.

Orthonota, from the Greek *orthos*, straight, and *notatus*, marked.

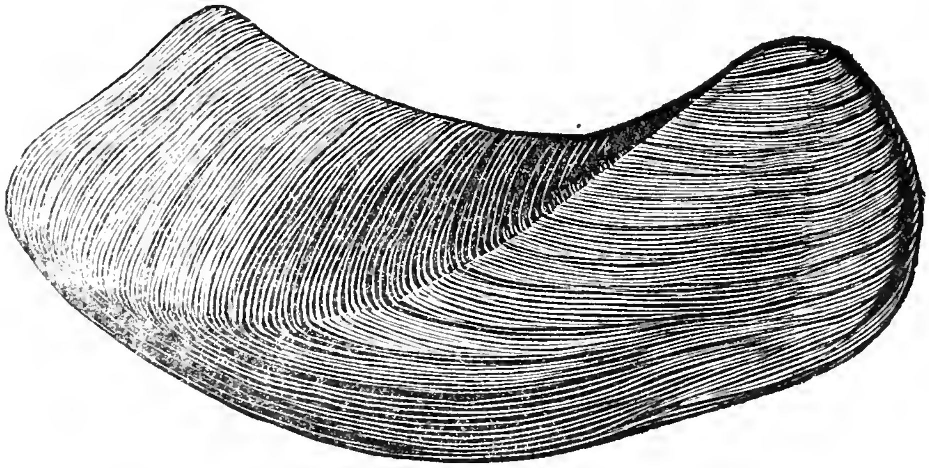


Fig. 12. *Cypricardia recurva.*

Fig. 12. *Cypricardia recurva* is given by Mr. Vanuxem, as being a common fossil of this group of rocks. It is remarkable for its curved form: hence the specific name.

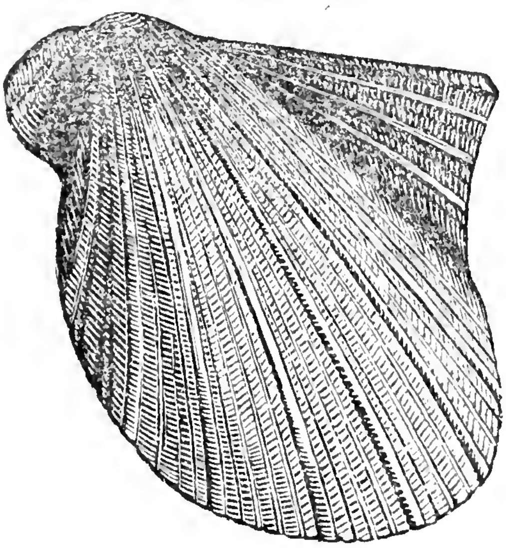


Fig. 13. *Avicula flabella.*

Fig. 13. *Avicula flabella* is another of Vanuxem's fossils, belonging to the Hamilton rocks.

The generic name is Latin, *Avicula*, a little bird; specific name *flabella*, a little fan.

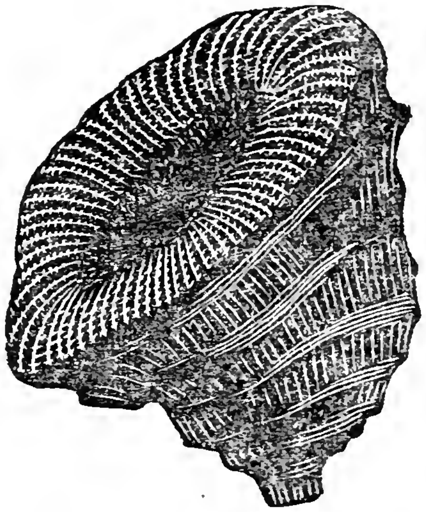


Fig. 14. *Heliophyllum Halli*, (Edwards & Haime.)

Fig. 14. *Heliophyllum Halli.* This species was described in the New York Reports under the name of *Cyothophyllum turbinatum*, but in a splendid work lately published in France,* wherein all the fossil corals then known of the palæozoic rocks are reviewed it is republished with the above new generic and specific appellations. We translate the description of the learned authors.

"Coral turbinated or cylindro-conic, in general somewhat lengthened and feebly curved at the base; covered by an epitheca, and presenting moderate concentric folds. Cup circular, moderately deep; one small septal fossette (a small cavity or furrow in one side of the bottom of the cup); radiating lamellæ very thin, regular; larger above, where they are rounded, denticulated on their free sides, alternately a little inequal; a little twisted towards the centre; they are 80 in number, or sometimes more. In a vertical section it is seen that the lateral prolongations of the lamellæ are arched and ascending; those which occupy the upper part of the chambers terminate at the free sides of the lamellæ; those which are situated lower unite in the centre to form irregular transverse septa; these prolongations, which close incompletely the interseptal spaces, are distant from each other a little more than a millemetre, and are united by simple cross pieces at right angles."

The generic name is from the Greek *Helios*, the sun, and *phyllon*, a plant. The specific name was given in honor of Professor Hall.

* *Polypiers fossiles des terrains palæozoiques (Fossil corals of the palæozoic formations,) par M. Edwards et J. Haime.*

Fig. 15 *Cystiphyllum Americanum*, (Edwards & Haime.)

Fig. 15 *Cystiphyllum Americanum*. "Coral elongated, cylindro-turbinate, straight or slightly curved, covered by a thin epitheca, and presenting folds of growth more or less marked. When the epitheca is removed, the striæ of very thin ribs may be observed. These are equal in size, and straight. The cup is circular, margins thin, excavated ; septal rays distinct and prolonged to the centre under the form of fine striae ; about one hundred may be counted. A verticle section shews a tissue entirely vesicular but which is very dense in the external parts of the fossil ; the vesicles occupying the outside are in general small and oblique sloping inwards and downwards ; those in the centre are larger, a little unequal, and almost horizontal, broader than high, the largest are three millemetres (about one eighth of an inch) in length and 1 or 1½ millemetres in heighth ; the small ones are only about one millemetre in breadth."

This species is the *C. cylindricum* of the New York reports. It occurs abundantly in the Hamilton Group in Western Canada. The star shaped mark near the centre of the figure is the base or root of a small encrinite which had attached itself to the specimen figured by Prof. Hall after the death of the coral.

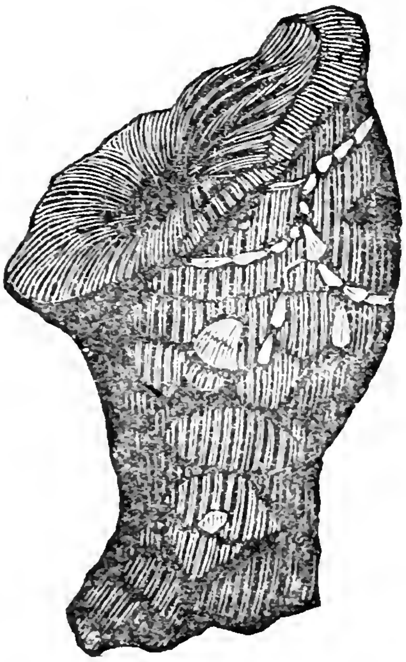
The generic name is derived from the Greek *kustis*, a vesicle, or small cavity. Fossils of this genus when cut and polished, or when their internal arrangement is otherwise exposed, do not exhibit the regularly radiated structure of *Streptelasma*, but consist altogether of vesicular structure. This species is usually four inches or less in length and 1 or 1½ in diameter.

Fig. 16. *Cyathophyllum distortum* (Hall)
Fig. 17 *Cyathophyllum rectum* (Hall.)

Fig. 16 *C. distortum.* " Coral elongated irregularly cylindro-turbinate, a little curved. Epitheca strong; folds of growth very much projecting and sharp-edged; radiating lamellae 26 to 34 in the adults. The general form varies greatly, some specimens are slender and long, others thick and short."

The length of this species is from one to two inches, diameter $\frac{1}{4}$ to $\frac{2}{3}$ of an inch. It is remarkable for the sharp inflections occasionally exhibited, some of the specimens are bent almost at a right angle. Abundant in western Canada.

Cyathophyllum from the Greek *knathus*, a cup.



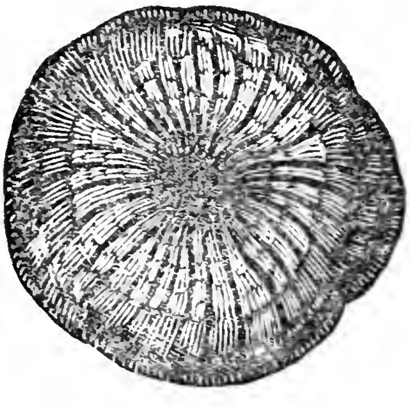


Fig. 18. *Strombodes simplex,* (Hall.)
Views of side and interior of the cup.

Fig. 17. *C. rectum.* " Coral turbinated, elongated, straight, or slightly curved; folds of growth very feeble; ribs simple, rather large, straight, sub-equal, corresponding to the interseptal spaces,

the distinct furrows on the sides indicate the outer edges of the lamellae ; the other less distinct furrows the edges of the rudimentary lamellae."

Length from 1 to 2 inches, diameter $\frac{2}{3}$ of an inch.

Specific name, Latin, *rectum*, straight.

Fig. 18. *Strombodes simplex.* Professor Hall thus describes this species. "Turbinate, curved near the base; disk expanded; thin on the edge, sometimes sub-reflexed; laminæ simple, much contorted in the centre, and irregularly bifurcating toward the margin (about 40 in number); surface marked by longitudinal striæ." "The simple prominent laminæ, and shallow cup, at once distinguish this species. It resembles the *S. plicatum* which occurs in the corniferous limestone."

The French authors appear to think this fossil to be a *cyathophyllum*, but do not give any decided opinion.

GAS *for illumination from the Utica slate. Professor Hind's Lecture before the Mechanics' Institute of Toronto, extracted from the Toronto Times*, 28*th January*, 1857.

"Last Friday evening, Professor Hind, of Trinity College, delivered his second lecture at the St. Lawrence Hall, before the members of the Toronto Mechanic's Institute.

"The lecture was a continuation of a former one, delivered the Friday previous. In describing the manufacture of illuminating gas, the lecturer illustrated the subject by a novel mode of preparing that useful and important means of obtaining artificial light, which we shall endeavour to describe.

"The lecturer exhibited before the audience the process of manufacturing coal gas for illuminating purposes, but the material he employed for generating the gas was a substance altogether different from coal, being nothing more than the bituminous shale, which is found in abundance at the base of the Blue mountains, near Collingwood. This shale extends from lake Ontario at Oshawa, to Collingwood on Georgian Bay. It is particularly rich in bitumen, and produces upon distillation, a very brilliant illuminating gas, together with tar and oils and other substances usually produced in making gas from ordinary coal. The apparatus employed by the lecturer, consisted of a small table furnace, in which was placed an iron retort, containing about half a pound of the shale broken up into small fragments. To the pipe leading from the retort, a small glass globe was attached, for receiving the tar and oil; from this receiver a glass tube led into a vessel containing lime water, through which the gas issuing from the shale in the red-hot retort was transmitted. To the same vessel a pipe and jet were fixed for burning the gas. Its illuminating power appeared to be greater than that from coal gas, and the lecturer stated that, while the London (England) gas contained on an average not more than from four to six per cent, of the illuminating principle which is called olefiant gas, and very good gas rarely possessed more than ten to twelve per cent, of its valuable constituent; this gas from the bituminous shale of Collingwood or Oshawa, held fifteen per cent, of the illuminating principle in the samples of gas which he had made and examined. The shale varies in the amount of bitumen it contains, so that the strength of the gas is not always the same. A valuable property of the Collingwood shale is that it does not swell or expand upon being heated, like bituminous coal, so that a retort may be filled with it, while it is well known, that it is not safe to fill a retort more than two-thirds of its capacity with bituminous coal. The Lecturer considered it possible that the shales of Collingwood and Oshawa may yet become of economic value, for the purposes of gas-lighting. Similar shales, but of very different geological age, are found in great abundance in the valley of the Sydenham and the Thames rivers near Chatham, and throughout the country between lake Huron and lake Erie, drained by those rivers.

"The geological name of the Collingwood and Oshawa shales was said to be "the Utica slate," and those of the western part of Canada, "the Hamilton shales."

"The lecturer also exhibited the mode of ascertaining the presence of noxious impurities in illuminating gas, and showed the absence of such impurities in the Toronto gas, by illustrative experiments. The tests for sulphuretted hydrogen and sulphuroeus acid, established conclusively that our Toronto gas, as then taken from the pipes in the St. Lawrence Hall, is perfectly free from those noxious impurities. The lecturer further expressed his opinion, that in isolated factories, and even in private families in the country, gas illumination from fat and oil, or other similar substances would soon become by no means uncommon. The apparatus is extremely simple and cheap, and attended with very little trouble, while the cost of lighting a large building or private house, when compared with candles or oil, was very trifling. The only objection that could be urged against its introduction in or near a private house, was the smell occasioned by the formation of volatile compounds of Carbon and Hydrogen, which chemists had not succeeded in separating by economical processes from common gas.

"The possibility of the economical manufacture of illuminating gas from our Collingwood, Oshawa, and Western shales, is a very interesting and important question, as many cubic miles of those shales, very rich in bitumen are found in Western Canada. Professor Hind also stated that the other products of the distillation of the shales, such as oil, tar, and naptha, are likely to be valuable. We hope we shall hear more of this subject, and that experiments will be set on foot to ascertain the commercial value of the Canadian rocks to which Professor Hind has now called the attention of the members of our flourishing Mechanic's Institute."

Date Due