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THE

CANADIAN

Naturalist and Geologist.

BY E. BILLINGS.

VOLUME I.

Montreal:
PRINTED BY JOHN LOVELL, AT HIS STEAM PRINTING ESTABLISHMENT
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1857.

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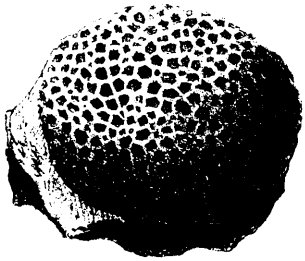

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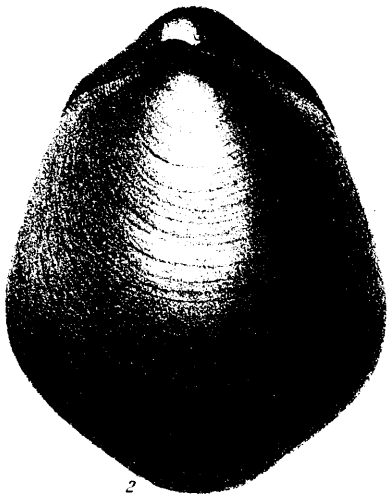

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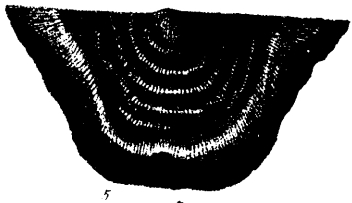

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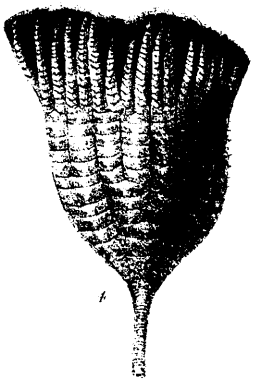

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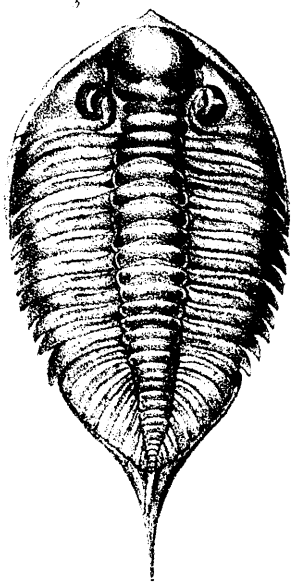

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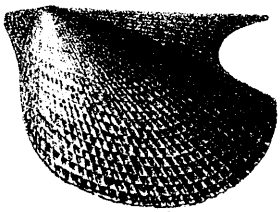

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THE

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.

THE CANADIAN NATURALIST AND GEOLOGIST.

BY E. BILLINGS.

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 exuviæ 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, bringing up with it, the deposit of marine remains accumulated upon it while submerged, appears to have been much favored by their ablest philosophers. Thus Aristotle in one of his works, says "the distribution of land and sea, in particular regions, does not endure throughout all time, but it becomes sea in those parts where it was land, and again it becomes land where it was sea: and there is reason for thinking that these changes take place according to a certain system, and within a certain period;" "neither the Tanais nor the Nile, can have flowed forever. The places where they rise were once dry, and there is a limit to their operations; there is none to time. So also of all other rivers; they spring up and they perish, and the sea 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 Palæozic 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 build-

ing 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 *Fucoides* 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	..	..	..	..	..	3	..	..
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	..	..	..	..	..	..	..	..	..	6	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.	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.
Beauharnois	—	—	12	11	10	9	--	--	--	--	--	...	...	..
Bellechasse	—	—	—	--	--	--	S	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	--	--	--	--	...	...	..
Otawa	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, leopard, 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 $1\frac{3}{4}$ inch in length, $\frac{3}{4}$ 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:

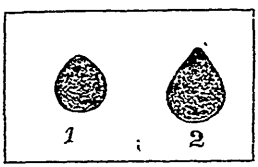


Fig 1. *Lingula prima.*
2. *Lingula antiqua.*

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.

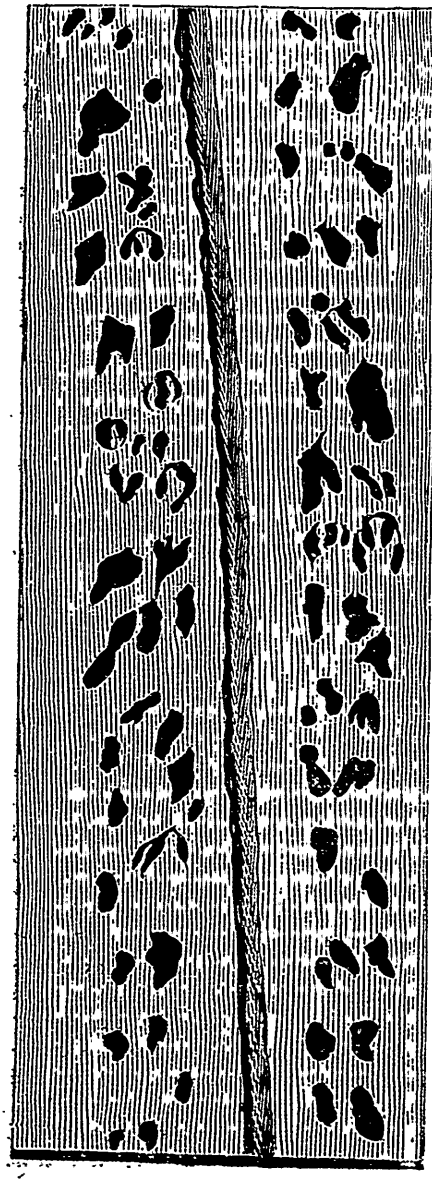
3. Fossil Foot-prints.

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.*

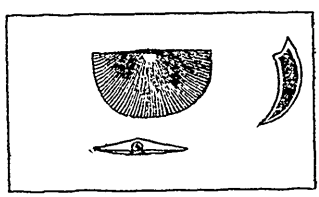


Fig 2. *Leptena sericia.*

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.

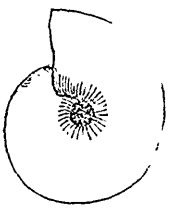


Fig. 5.

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.*

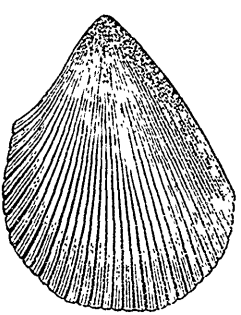


Fig 7. *Ambonychia radiata.*

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.

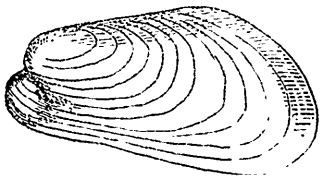


Fig. 8.—*Modiolopsis modioloris.*

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.

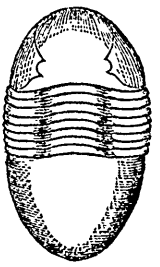


Fig. 9.

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.

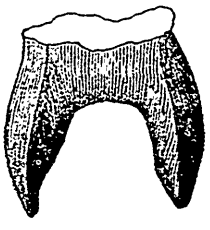


Fig 11 represents a part of *I gigas*, called the *hypostoma*, an organ which appears to have been analogous to the *labrum* or upper lip of the insects of the present day. The hypostoma is often found separated from the other portions of the trilobites. The one figured, belonged to an *I. gigas* of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

Fig 11. *Hypostoma of Isotelus Gigas.*

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 uninterruptedly 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.

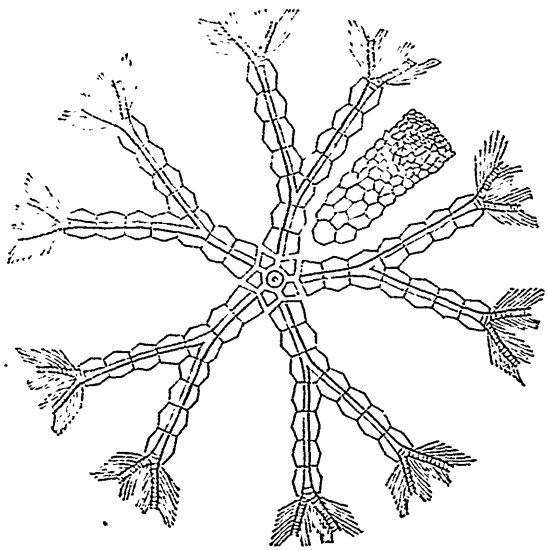


Fig. 1.

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.

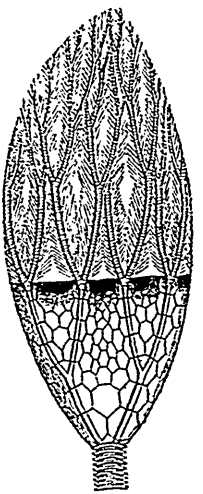


Fig. 2.

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 these 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 calcareous 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.

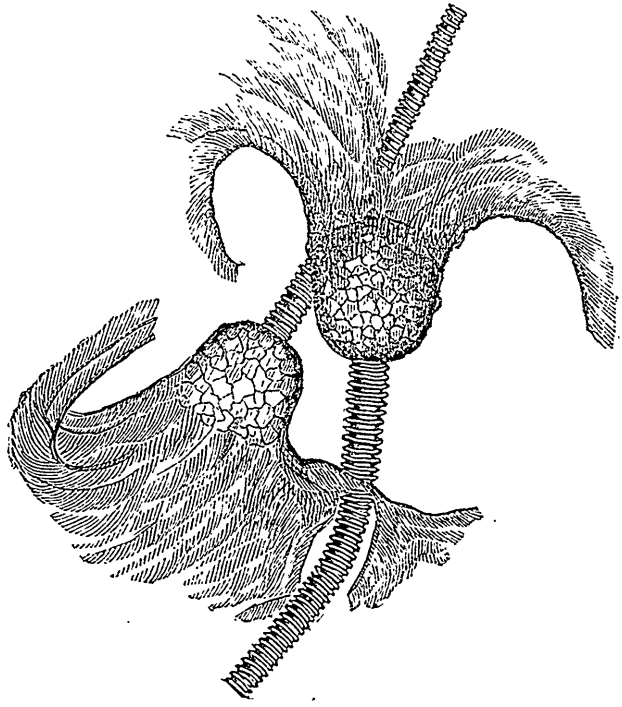
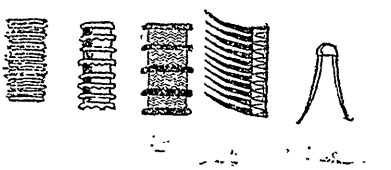


Fig. 3.—*Glyptocrinus ramulosus.* New species, Trenton limestone, Brigham's Lake, Township of Hull, County of Ottawa.

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 hal," 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 be-

tween 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

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."—PALEONTOLOGY 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 bastalis.*) 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, *mousse*, "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 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 bempen 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.

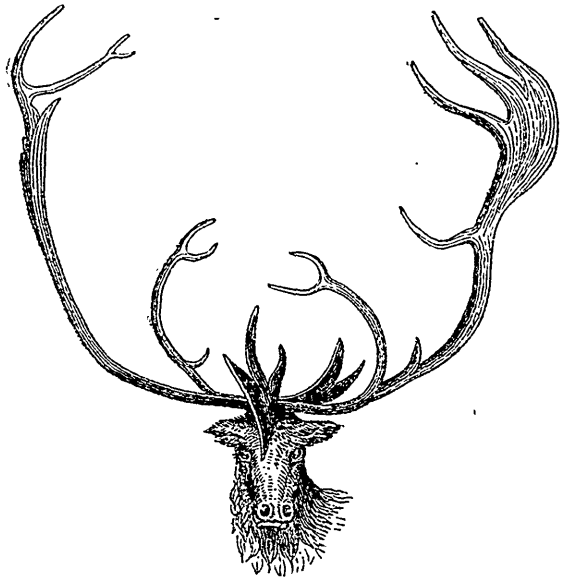
DENTAL FORMULA.

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

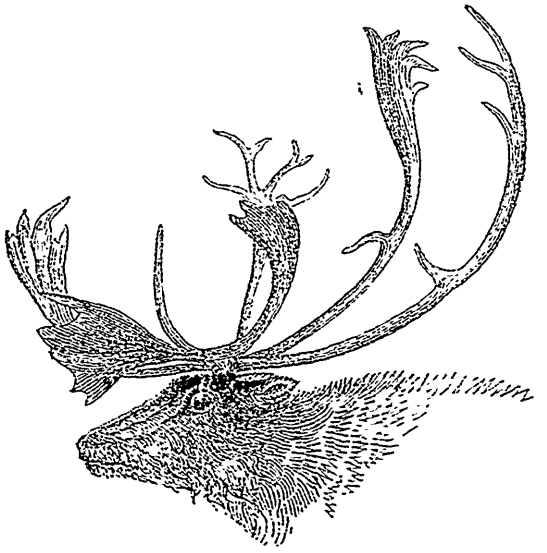
There are two species of Reindeer, commonly called Caribou, in North America, confined in their geographical distribution to the eastern and northern portions of the continent. One of these, the subject of the present

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 the 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*, *cornicularieæ*, 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 seeen, 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 resembles 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 settlement 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 galloping 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*.