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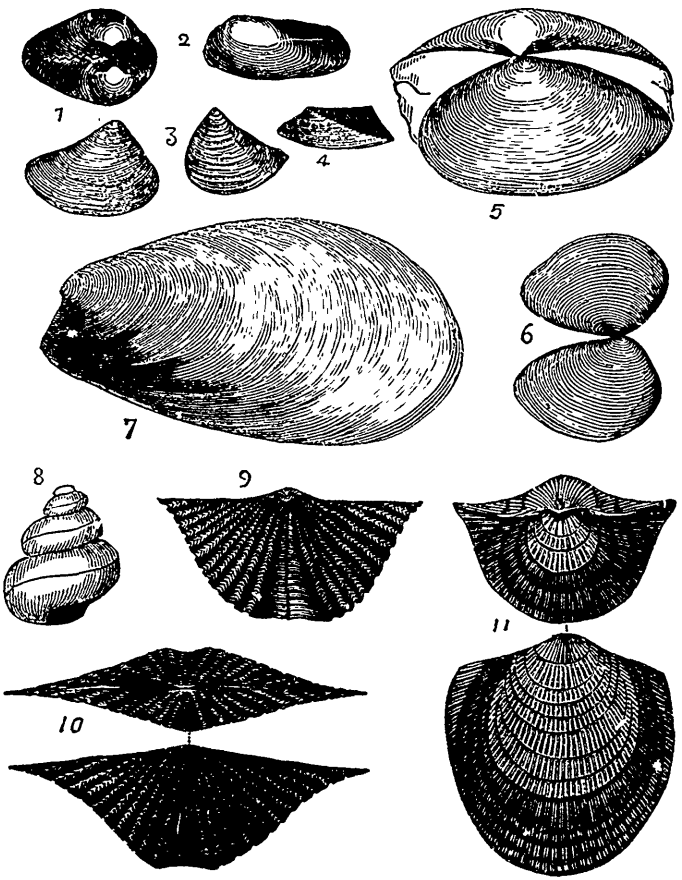
FOSSILS OF THE HAMILTON GROUP.



1.—*Cucullea opima.*
2.—*Nucula oblonga.*
3.—*Nucula lineata.*
4.—*Cypricardia truncata.*
5.—*Tellina? ovata.*
6.—*Nucula bellatula.*
7.—*Modiola concentrica.*
8.—*Turbo lineatus.*
9 & 10.—*Spirifer mucronatus.*
11.—*Atrypa prisca.*

THE

CANADIAN

NATURALIST AND GEOLOGIST.

BY E. BILLINGS.

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ARTICLE LVI.—*On American Geological History*:—Address before the American Association for the Advancement of Science, August, 1855, by JAMES D. DANA.*

(*Concluded.*)

As plants may live in water too hot or impure for animals, and moreover, since all nature exemplifies the principle that the earth's surface was occupied with life as soon as fitted, and with the highest forms the conditions of the time allowed, we may reasonably infer that there may have been in Azoic times marine species and plant-infusoria forms adapted to aid in the earth's physical history; and thus vegetation may have long preceded animal life on the globe.†

* Silliman's American Journal of Science, November, 1856.

† The evidence with respect to the existence of plants in the Azoic Age, though by no means positive, is stronger than here stated.—In the *first* place, there are *limestones* among the folded strata; and as limestones of later ages were almost wholly of organic origin, these of Azoic rocks *may*

After these general remarks on the divisions of Geological time, I now propose to take up the characteristic features and succession of events in American Geology.

In the outset we are struck with the comparative simplicity of the North American continent, both in form and structure. In *outline*, it is a triangle, the simplest of mathematical figures; in *surface*, it is only a vast plain lying between two mountain ranges, one on either border, the Appalachian from Labrador to Alabama on the east, the Rocky Mountains on the west; and on its *contour* it has water, east, west, north and south.

Observe too that its border heights are proportioned to the size of the oceans. A *lofty* chain borders the Pacific, a *low* one the narrow Atlantic, while the small Arctic sea is faced by no proper mountain range.

This principle, that the highest mountains of the continents face the largest oceans, is of wide application, and unlocks many mysteries in physical geography. South America lies between the same oceans as North America: it has its eastern low range, its western Andes; and as the oceans widen southward, the continent is there pinched up almost to a narrow mountain ridge. It differs from North America in having a large expanse of ocean, the Atlantic, on the north; and, correspondingly, it has its northern mountain ridges. The world is full of such illustrations, but I pass them by.

This simplicity of ocean boundary, of surface features, and of outline, accounts for the simplicity of geological structure in North America. We may make indeed the wider statement, that all these qualities are some way connected with the positions and extent of the oceans, they seeming to point to the conclusion, that the subsidence of the oceanic basins had determined the continental features; and that farther, both results were involved in the earth's gradual refrigeration, and consequent contraction.

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also have been so.—2nd, *Graphite* is a common mineral in some of the crystalline rocks, and graphite is known to result from the alteration by heat of the carbon of plants.—3rd, the Huronian rocks, according to Sir W. E. Logan, actually contain some small seams of anthracite.—4th, Vegetation, as it is directly or indirectly the food of animals, should necessarily have preceded animal life.—With reference to the statement in the text above, it should be noted that vegetation has been observed growing among the Geysers of Iceland, in waters having a temperature of 180° F.; and the writer has seen a case of similar kind, on Luzon, one of the Philippines, where the temperature was 160° F. This is much beyond the limit, which the eggs of animals can endure and survive.

America has thus the simplicity of a single evolved result. Europe, on the contrary, is a world of complexities. It is but one corner of the Oriental continent,—which includes Europe, Asia, and Africa,—and while the ocean bounds it on the north and and west, continental lands inclose it on the south and east. It has ever been full of cross purposes. American strata often stretch from the Atlantic west beyond the Mississippi; and east of the Rocky Mountains, it has but one proper mountain range of later date than the Silurian. Europe is much broken up into basins, and has mountains of all ages: even the Alps and Pyrenees are as recent as the Tertiary.

This wide contrast accounts for the greater completeness or generality of American revolutions, the more abrupt limits of periods, and clearer exhibition of many geological principles.

The geological structure of this country has been made known through the combined researches of a large number of investigators. The names of MACLURE, SILLIMAN, EATON, lead off the roll; HITCHCOCK, the Professors ROGERS, the well-known GEOLOGISTS of the NEW YORK SURVEY, also, OWEN, PERCIVAL, MORTON, CONRAD, TUOMEY, and many others, have made large contributions to the accumulating results. Yet the *system* may be said to have been mainly laid open by four sets of observers, —MORTON for the Cretaceous; CONRAD for the Tertiary; the NEW YORK GEOLOGISTS for the Palæozoic strata; and the Professors ROGERS for the Carboniferous beds and the Appalachians.

The succession of Silurian and Devonian rocks in the State of New York is the most complete in the country, and it was well for the science that its rocks were so early studied, and with such exactness of detail. The final display of the Palæontology by Mr. James Hall has given great precision to the facts, and the system has thereby become a standard of comparison for the whole country, and even for the world.

This accomplished, the Carboniferous rocks were still to be registered, and the grand problem of New England Geology solved. The Professors Rogers, in the surveys of Pennsylvania and Virginia, followed out the succession of strata from the Devonian through the Coal Period, and thus, in a general way, completed the series. And more than this, they unravelled with consummate skill the contortions among the Appalachians, bringing order out of confusion, and elucidating a principle of mountain-making which is almost universal in its application. They

showed that the Silurian, Devonian, and Carboniferous strata, which were originally laid out in horizontal layers, were afterwards pressed on to the north-westward, and folded up till the folds were of mountain height, and that thus the Appalachians had their origin; and that also, by the escaping heat of those times of revolution, extensive strata were altered, or even crystallized.*

* As I have already remarked, many names are above omitted which have contributed largely to our knowledge of American Geology.

While Dr. MORTON was the first to distinguish the North American *Cretaceous* beds, and pursued his researches with great energy and skill, they have been largely studied also by LYELL in different localities on the east and south, by NICOLLET and recently SHUMARD, HAYDEN, MEEK and HALL, on the beds west of the Mississippi, by ROEMER in Texas, TUOMEY in South Carolina, H. D. ROGERS and others in New Jersey, J. W. BAILEY with reference to microscopic species, and J. LEIDY for Vertebrate Remains.

The *Tertiary* has been investigated by LYELL along both the eastern and southern border; also in different localities by MORTON, M. TUOMEY, F. S. HOLMES, C. S. HALE, I. LEA, H. D. and W. B. ROGERS, ROEMER, J. D. DANA and W. P. BLAKE for the tertiary of the Pacific coast, BAILEY for minute species, HARLAN, OWEN, MULLER, PROUT, LEIDY, WYMAN and GIBBES, for Vertebrate fossils; while these and many other authors have published on the *post-tertiary* deposits and organic remains.

The *Silurian* and *Devonian* systems have occupied the attention of nearly all who have written on American Geology, in the East or West, among whom, there are:—HALL, MATHER, VANUXEM, EMMONS, CONRAD, De VERNEUIL of Paris, the Professors ROGERS Messrs. WHITNEY and FOSTER, D. D. OWEN, C. T. JACKSON, D. HOUGHTON of Michigan, G. TROOST and lately J. M. SAFFORD of Tennessee, J. GREENE, J. LOCKE, C. WHITTLESEY, I. A. LAPHAM, G. C. SWALLOW, J. G. NORWOOD, B. F. SHUMARD, besides the investigators in Canada, Sir W. E. LOGAN, J. BIGSBY, J. W. DAWSON, T. S. HUNT and others.

The *Carboniferous* formation was early studied in many of its details by Dr. S. P. HILDRETH. But the successive strata of the whole formation from the Devonian through the Subcarboniferous and Coal Measures, were first systematized by the Professors ROGERS, though without yet marking out in any of their publications the subdivisions of the coal measures themselves and the characteristic fossils of each, as had been done for the Devonian and Silurian by the New York Geologists. Other researches on the coal beds have been made by R. C. TAYLOR and J. P. LESLIE in Pennsylvania, J. HALL, D. D. OWEN, and others in the states of the Mississippi valley, J. S. NEWBERRY on the fossil plants and fishes of the Ohio coal measures, HITCHCOCK and C. T. JACKSON on the coal beds of Rhode Island; DAWSON, LYELL, JACKSON, &c., on the new Brunswick and Nova Scotia beds; LEA, WYMAN, LEIDY, LYELL and DAWSON on Reptillian and other carboniferous fossils.

This key soon opened to us a knowledge of New England geology, mainly through the labors of Prof. Hall, and also of Professor H. D. Rogers, following up the survey of President Hitchcock; and now the so-called primary rocks, granite, gneiss, schists, and crystalline limestones, once regarded as the oldest crystallizations of a cooling globe, are confidently set down as for the most part no older than the Silurian, Devonian, and Carboniferous of New York and Pennsylvania. *

Let us now briefly review the succession of epochs in American geological history.

The Azoic Age ended, as was observed, in a period of extensive metamorphic action and disturbance,—in other words, in a vast revolution. At its close, some parts of the continent were left as dry land, which appear to have remained so, as a general thing, in after times; for no subsequent strata cover them. Such are a region in Northern New York, others about and beyond Lake Superior, and a large territory stretching from Labrador westward,

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The parallelism of the rock formations of the east and west has been determined mainly through the researches of Prof. HALL, who first presented his views on the subject in 1841, and continues still his investigations. The examinations of DE VERNEUIL; besides defining the limits of our Devonian, also contributed much on this subject.

The red sandstone and trap regions of the Triassic or Jurassic period, which occur in the Connecticut valley and in other valleys parallel with the Atlantic border to the south, and also to the north beyond Nova Scotia, have been specially investigated by D. OLMSTED, E. HITCHCOCK, J. G. PERCIVAL, Professors ROGERS, E. EMMONS, J. W. DAWSON, C. T. JACKSON, F. ALGER; and as regards the vertebrate fossils, by E. HITCHCOCK, J. DEANE, W. C. REDFIELD, J. H. REDFIELD, J. WYMAN, J. LEIDY, I. LEA, and Prof. OWEN of London; and the plants, by the Professors ROGERS, C. T. F. BUNBURY, and E. HITCHCOCK, Jr.

* The labors of Sir W. E. LOGAN have thrown great light upon New England geology, and are giving a definiteness to our knowledge hitherto unattained. He is finding that some of the crystalline New England rocks which stretch north into Canada, are there uncrystalline and fossiliferous, and thus is putting the question of age beyond doubt. The Berkshire limestone has thus been determined at its northern extremity as well as in New Jersey; the calcareous mica slate of western Vermont, has been shown to be Upper Silurian in age, it being uncrystalline limestone towards Gaspé, partially metamorphic and still containing distinct traces of fossils in the valleys of the river St. François and Lake Memphrem 70g, and farther south becoming more crystalline as well as calcareous and losing all indications of fossils. Prof. T. S. Hunt of the Canada Survey, has brought other facts to bear on this subject.

as recognized by Messrs. Foster and Whitney and Prof. Hall, and the geologists of Canada.*

The Silurian or Molluscan Age next opens. The lowest rock is a sandstone, one of the most widely spread rocks of the continent, stretching from New England and Canada south and west, and reaching beyond the Mississippi,—how far is not known. And this first leaf in the record of life is like a title page to the whole volume, long afterwards completed; for the nature of the history is here declared in a few comprehensive enunciations.

1. The rock, from its thin, even layers, and very great extent, shows the wide action of the ocean in distributing and working over the sands of which it was made; and the ocean ever afterward was the most active agency in rock-making.

2. Moreover, ripple marks, such as are made on our present seashores or in shallow waters, abound in the rock, both through the east and west, and there are other evidences also of moderate depths, and of emerged land.† They all announce the wonderful fact, that even then, in that early day, when life first began to light up the globe, the continent had its existence,—not in embryo, but of full-grown extent; and the whole future record is but a working upon

* The Azoic lands, above the ocean at this time, recognized by Messrs. Foster and Whitney in the Report referred to, were that of the Azoic region, between Lake Superior and Hudson's Bay, that between Lake Superior and Lake Michigan, the Azoic Island of Northern New York; and the facts they state would add the Missouri iron-mountain region, and the metamorphic region of Arkansas as possibly other islands. Mr. Whitney has more recently shown that the occurrence of great masses of specular or magnetic iron is proof that the metamorphic rocks containing them are of the Azoic age or præ-Silurian.

On the Geological map of northern North America, published by Mr. Isbister in the Quarterly Journal of the Geological Society for 1855, xi, 497, the Azoic is shown to extend in a narrow band northwestward from Canada to the Arctic sea between Hudson's Bay and the Winnipeg line of small lakes.

† Other marks of shallow water alluded to are wave lines, and the oblique lamination characterising many subordinate layers in the rock,—the latter due to changing currents, like the ebb and flow of tides, or variations in tidal or other currents, or the occasional actions of storm waves. This oblique lamination as well as ripple marks, occurs abundantly in the Potsdam sandstone of northern New York (Emmons' Geol. Rep., p. 104, 130); in Canada (Logan's Reports, 1851–52, p. 12 and elsewhere); south of Lake Superior (Foster and Whitney, loc. cit. p. 118); in the Upper Mississippi (Owen, Survey of Wisconsin, &c., p. 48); in Pennsylvania and Virginia (Professors H. D. and W. B. Rogers).

the same basis, and essentially within the same limits. It is true that but little of it was above the sea, but equally true that little of it was at great depths in the ocean.

3. Again, in the remains of life which appear in the earliest layers of this primal rock, three of the four great branches of the Animal Kingdom are represented,—Mollusks, Trilobites among Articulates, and Corals and Crinoids among Radiates,—a sufficient representation of life for a title-page. The New York beds of this rock had afforded only a few mollusks; but the investigations of Owen and others have added the remaining tribes; and this diversity of forms is confirmed by Barrande in his Bohemian researches.*

Among the genera, while the most of them were ancient forms that afterwards became extinct, and through succeeding ages thousands of other genera appeared and disappeared; the very earliest and most universal was one that now exists,—the genus *Lingula*, —thus connecting the extremes of time, and declaring most impressively the unity of creation. Mr. T. S. Hunt, of the Canada Geological Survey, recently discovered that the ancient shell had the anomalous chemical constitution of bones, being mainly phos-

* The *Lingula prima* and *L. antiqua* are the Mollusks referred to as occurring in the New York beds. The discoveries by Owen, in the vicinity of the Falls of the St. Croix, Minnesota, and on the Mississippi, were published by him in his Report on a *Geological Reconnaissance of the Chippewa Land District of Wisconsin and the Northern part of Iowa*, Washington (Senate Document), 1848, p. 14, and subsequently in his quarto Report on Wisconsin, &c., of 1852. The fossils he mentions in the latter work are species of *Lingula, Obolus, Orbicula, Orthis*, several forms of Crinoids, and large Trilobites referred mostly to the new genus *Dikelocephalus*. The species as named are, *Lingula antiqua, L. prima, L. pinnaformis* Owen, L. *ampla* Owen, *Obolus Apollinis* (?), *Orbicula prima* O., *Dikelocephalus Minnesotensis* O., *D. Miniscaencis* O., *D.* (?) *Iowensis* O., *D. granulosus* O., *D. Pepinensis* O., *Conocephalus Chippewaensis* O., *Crepicephalus* (?) *Wisconsensis* O., *C. Miniscaensis* O.

Prof. W. B. Rogers in the last number of this Journal (p. 296), announced the discovery of the Trilobite *Paradoxides Harlani* of Green (*P. spinosus* of Barrande) in slates ten miles south of Boston, Mass., a species found by Barrande in his protozoic or earliest fossiliferous rock of Bohemia,—thus adding a new species to the American protozoic Fauna, and the largest yet discovered, the length of some of the specimens exceeding a foot. Prof. E. Emmons announces also (Meeting of Amer. Assoc. in August last, at Albany) the discovery of a large Cyathophylloid coral in the lowest fossiliferous rocks of North Carolina. The exact age of the rock however is yet uncertain.—See a notice beyond in this number.

phate of lime; and afterwards he found in a modern Lingula the very same composition,—a further announcement of the harmony between the earliest and latest events in geological history.*

This earliest sandstone,—called in New York the Potsdam sandstone,—and the associated Calciferous sand-rock, mark off the *First Period* of the Molluscan Age,—the POTSDAM PERIOD, as it may be called.†

Next followed the TRENTON PERIOD,—a period of limestones, (the Trenton limestone among them,) equal to the earlier beds in geographical limits, and far more abundant in life, for some beds are literally shells and corals packed down in bulk; yet the species were new to the period, the former life having passed away; and even before the Trenton Period closed, there were three or four epochs of destruction of life followed by new creations. The formation of these limestone beds indicates an increase in the depth of the continental seas,—an instance of the oscillation of level to which the earth's crust was almost unceasingly subject through all geological ages until the present.

After the Trenton Period, another change came over the continent, and clayey rocks or shales were formed in thick deposits in New York, and south,—the Utica slate and Hudson River shales,—while limestones were continued in the West. This is the HUDSON PERIOD; and with it, the *Lower Silurian* closed.‡

The seas were then swept of their life again, and an abrupt transition took place both in species and rocks. A conglomerate covered a large part of New York and the States south, its coarse

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* Am. Jour. Sci., [2], xvii, 235, (1854).

† Through the comparisons of Prof. Hall, it is now well known that the "Lower Magnesian Limestone" of the west, and a sandstone with which it alternates, correspond to the Calciferous sandrock of New York.

‡ Prof. Hall, in connection with J. D. Whitney, has recently made the important observation, that the Galena or lead-bearing limestone, which is the upper member of the Trenton group, is separated from the Niagara limestone in Iowa and Wisconsin by thick strata of Hudson River shales, giving a prolongation to these shales before unsuspected. He had previously, with Mr. Whitney, traced these shales around the north side of Lake Huron and Lake Michigan to Pointe aux Baies, and thence along Green Bay to Lake Winnebago. These shales are however partly replaced by limestone in Ohio, &c.

material evidence of an epoch of violence and catastrophe: and with this deposit the *Upper Silurian* began.

The Upper Silurian has also its three great periods,—the NIAGARA, the ONONDAGA, and the LOWER HELDERBERG, besides many subordinate epochs,—each characterized by its peculiar organic remains,—each evidence of the nearly or quite universal devastation that preceded it, and of the act of omnipotence that reinstated life on the globe,—each, too, bearing evidence of shallow or only moderately deep waters when they were formed; and the Onondaga Period,—the period of the New York salt rocks—telling of a half-emerged continent of considerable extent.

Another devastation took place, and then opened, as De Verneuil has shown, the Devonian Age or Age of Fishes. It commenced, like the Upper Silurian, with coarse sandstones, evidence of a time of violence; these were followed by another grit rock, whose few organic remains show that life had already reappeared. Then another change,—a change evidently in depth of water,—and limestones were forming over the continent, from the Hudson far westward: the whole surface became an exuberant coral reef, far exceeding in extent, if not in brilliancy, any modern coral sea; for such was a portion, at least, of the UPPER HELDERBERG Period.

Again there was a general devastation, leaving not a trace of the former life in the wide seas; and where were coral reefs, especially in the more eastern portion of the continental seas, sandstones and shales accumulated for thousands of feet in thickness, with rarely a thin layer of limestone. Thus passed the HAMILTON, CHEMUNG and CATSKILL Periods, of the Devonian age. The life of these regions, which in some epochs was exceedingly profuse, was three or four times destroyed and renewed—not renewed by a re-creation of the same species, but by others; and although mostly like the earlier in genera, yet each having characteristic marks of the period to which it belonged. And while these Devonian Periods were passing, the first land plants appeared, foretellers of the age of verdure, next to follow.

Then come vast beds of conglomerate, a natural opening of a new chapter in the record, and here it is convenient to place the beginning of the Carboniferous Age, or the Age of Acrogens. Sandstones and shales succeeded, reaching a thickness in Pennsylvania and New Jersey, according to the Professors Rogers, of thousands of feet; while in the basin of the Ohio and Mississippi,

in the course of this era, the Subcarboniferous limestone was forming from immense Crinoidal plantations in the seas.*

Another extermination took place of all the beautiful life of the waters, and a conglomerate or sandstone was spread over the encrinital bed: and this introduced the true coal period of the Carboniferous Age;—for it ended in leaving the continent, which had been in long-continued oscillations, quite emerged. Over the regions where encrinites were blooming, stretch out vast wet prairies or marshes of the luxuriant coal vegetation. The old system of oscillations of the surface still continues, and many times the continent sinks to rise again,—in the sinking, extinguishing all continental life, and exposing the surface to new depositions of sandstone, clays, or limestone, over the accumulated vegetable remains; in the rise, depopulating the seas by drying them up, and preparing the soil for verdure again; or at times, convulsive movements of the crust carrying the seas over the land, leaving destruction behind. And thus, by repeated alternations, the coal period passes, some six thousand feet of rock and coal-beds being formed in Pennsylvania, and fourteen thousand feet in Nova Scotia.

I have passed on in rapid review, in order to draw attention to the series or succession of changes, instead of details.† So brief an outline may lead a mind not familiar with the subject to regard the elapsed time as short; whereas to one who follows out the various alternations and the whole order of events, the idea of *time immeasurable* becomes almost oppressive.

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* This Subcarboniferous limestone is sparingly represented in Pennsylvania among the sandstones and shales; but according to Prof. W. B. Rogers it increases to the southward, and in Virginia acquires a thickness of 1500 to 2000 feet.

† The names given to the subdivisions of the Palæozoic rocks are the same that have been laid down by the New York Geologists, whose assiduous and successful labors in a territory of so great geological importance, entitle them to pronounce upon the nomenclature of American Rocks. I have varied from the ordinary use of the terms only in applying them to the periods and epochs when the rocks were formed, so as to recognize thereby the historical bearing of geological facts. The Periods and Epochs thus made out are as follows—excluding minor subdivisions which may make Sub-epochs, and not attempting to give the parallel subdivisions for the West. On this subject, the volumes and papers by Prof. Hall especially should be consulted.

I.—SILURIAN AGE.

1. *Lower Silurian.*

1. POTSDAM PERIOD.—1st Epoch. Potsdam sandstone: 2nd. Calciferous sandrock.

2. TRENTON PERIOD.—1st Epoch. Chazy limestone; 2nd. Birdseye; 3rd. Black River; 4th. Trenton.

3. HUDSON PERIOD.—1st. Epoch. Utica Shale; 2nd. Hudson River Shale. (Hudson River Shale and Blue limestone of Ohio in parts of the west.)

2. *Upper Silurian.*

1. NIAGARA PERIOD.—1st. Epoch. Oneida Conglomerate; 2nd. Medina Sandstone; 3rd. Clinton Group; 4th. Niagara Group.

2. ONONDAGA PERIOD.—1st. Epoch. Galt limestone; 2nd. Onondaga Salt Group.

3. LOWER HELDERBERG PERIOD.—Limestones. (Statement of epochs here omitted.)

II. DEVONIAN AGE.

1. ORISKANY PERIOD.—1st Epoch. Oriskany Sandstone; 2nd. Candagalli Grit.

2. UPPER HELDERBERG PERIOD.—1st Epoch. Schoharie Grit; 2nd. Upper Helderberg group.

3. HAMILTON PERIOD.—1st Epoch. Marcellus Shales; 2nd. Hamilton group; 3rd. Genesee Slate.

4. CHEMUNG PERIOD.—1st Epoch. Portage; 2nd. Chemung group.

5. CATSKILL PERIOD.—Catskill Red Sandstones and Shales. (No. IX. of Rogers.)

III. CARBONIFEROUS AGE.

1. SUBCARBONIFEROUS PERIOD.—1st Epoch. Conglomerates, Sandstones and Shales (with some coal seams;) 2nd. Sandstones, Shales and Carboniferous limestone. Nos. X. and XI. of Rogers.

2. CARBONIFEROUS PERIOD.—1st Epoch. Millstone Grit; 2nd. Lower Coal Measures; 3rd. Upper Coal Measures. Nos. XII. and XIII. of Rogers.

3. PERMIAN PERIOD.—Probably unrepresented in Eastern North America, except by the events of the Appalachian Revolution.

Before continuing the review, I will mention some conclusions which are here suggested.

I. In the first place, through the periods of the Silurian and Devonian, at twelve distinct epochs at least, the seas over this American continent were swept of all or nearly all existing life, and as many times they were repeopled: and this is independent of many partial exterminations and renewals of life that at other times occurred.

If Omnipotent Power had been limited to making *monads* for after development into higher forms, many a time would the

whole process have been utterly frustrated by hot water, or by mere changes of level in the earth's crust, and creation would have been at the mercy of dead forces. The surface would have required again and again the sowing of monads, and there would have been a total failure of crops after all; for these exterminations continue to occur through all geological time into the Mammalian Age.

II. Again: I have observed that the continent of North America has never been the deep ocean's bed, but a region of comparatively shallow seas, and at times emerging land; and was marked out in its great outlines even in the earliest Silurian. The same view is urged by De Verneuil, and appears now to be the prevailing opinion among American geologists. The depth at times may have been measured by the thousand feet, but not by miles.

III. During the first half of the lower Silurian era, the whole east and west were alike in being covered with the sea. In the first or Potsdam Period, the continent was just beneath or at the surface. In the next or Trenton Period, the depth was greater, giving purer waters for abundant marine life. Afterwards, the east and west were in general widely diverse in their formations; limestones, as Mr. Hall and the Professors Rogers have remarked, were generally in progress over the west, that is, the region, now the great Mississippi Valley, beyond the Appalachians, while sandstones and shales were as generally forming from northeastern New York south and southwest through Virginia. The former therefore, has been regarded as an area of deeper waters, the latter as, in general, shallow, when not actually emerged. In fact, the region towards the Atlantic border, afterwards raised into the Appalachians, was already, even before the Lower Silurian era closed, the higher part of the land: it lay as a great reef or sand-bank, partly hemming in a vast continental lagoon, where corals, encrinites and mollusks grew in profusion, thus separating more or less perfectly the already existing Atlantic from the interior waters.

IV. The oscillations or changes of level over the continent, through the Upper Silurian and Devonian, had some reference to this border region of the continent: the formations approach or recede from it, and sometimes pass it, according to the limits of the oscillations eastward or westward. Along the course of the border itself there were deep subsidences in slow progress,

as it shown by the thickness of the beds. It would require much detail to illustrate these points, and I leave them with this bare mention.

The Hudson River and Champlain valleys appear to have had their incipient origin at the epoch that closed the Lower Silurian; for while the preceding formations cross this region and continue over New England, the rocks of the Niagara and Onondaga Periods (the first two of the Upper Silurian) thin out in New York before reaching the Hudson River. Mr. Logan has recognized the division of America to the northeast into two basins by an anticlinal axis along Lake Champlain, and observes also that the disturbances began as early, at least, as the close of the Lower Silurian, mentioning, too, that there is actually a want of conformity at Gaspé between the beds of the Upper and Lower Silurian,—another proof of the violence that closed the Lower Silurian era.*

But let us pass onward in our geological record.

All the various oscillations that were in slow movement through the Silurian, Devonian, and Carboniferous Ages, and which were increasing their frequency throughout the last, rais-

* This Eastern border of the American continent, then in process of formation over the present Appalachian region from Labrador and Canada southwestward, lay deeper to the south than to the north. In Canada and the Azoic of Northern New York, there was land out of water, forming its northern limit. From thence it stretched on with its gradually deepening waters, though varying constantly with the oscillations. The thickness of many of the sedimentary beds passing southward from the New York Azoic prove this increasing depth to have been a general fact; and it is corroborated by a statement made by Professor W. B. Rogers (meeting of American Association in August last at Albany,) that the subcarboniferous sandstones and shales containing but little limestone in Pennsylvania, were replaced by beds of the subcarboniferous limestone which to the south in Virginia reach a great thickness (see note to page 317)—the limestones indicating clearer and somewhat deeper waters. The early disturbances and uplifts *in the northeast* near Gaspé and along the Hudson valley also accord with this view.

Again, the position of the Azoic dry land in Canada and of the sedimentary rocks south and southwest, shows us that the Continent in those early times received the northern Labrador current,—which would have kept by the shore as now, along the eastern border of this Azoic,—over New Brunswick and Nova Scotia, and that thence its natural course would have been southwest over the Appalachian region, where the sandstones and shales were extensively accumulated; and therefore its aid in making these deposits can scarcely be doubted.

ing and dipping the land in many alternations, were premonitions of the great period of revolution,—so well elucidated, as already observed, by the Professors Rogers,—when the Atlantic border, from Labrador to Alabama, long in preparation, was at last folded up into mountains, and the Silurian, Devonian, and Carboniferous rocks were baked or crystallized. No such event had happened since the revolution closing the Azoic Period. From that time on, all the various beds of succeeding ages up to the top of the Carboniferous had been laid down in horizontal or nearly horizontal layers, over New England as well as in the west,—for the continent from New England westward, we have reason to believe, was then nearly a plain, either above or below the water; there had been no disturbances except some minor uplifts: the deposits, with small exceptions, were a single unbroken record, untill this Appalachian revolution.*

This epoch, although a time of vast disturbances, is more correctly contemplated as an epoch of the slow measured movement of an agency of inconceivable power, pressing forward from the ocean towards the northwest; for the rocks were folded up without the chaotic destruction that sudden violence would have been likely to produce. Its greatest force and its earliest beginning was to the northeast. I have alluded to the disturbance between the Upper and Lower Silurian beds of Gaspé, to the north. Another epoch of disturbance, still more marked, preceded, according to Mr. Logan, the Carboniferous beds in those northeastern regions; and New England, while a witness to the profound character and thoroughness of the Appalachian revolution, attests also to the greater disturbance towards its northern limits. Some of the Carboniferous strata were laid down in Rhode Island as clay and sand and layers of vegetable debris: they came forth from the Appalachian fires as we now have them, the beds contorted, the coal layers a hard siliceous anthracite or even graphite in places, the argillaceous sands and clays crystallized as talcose schist, or perhaps gneiss or syenite.

These very coal-beds, so involved in the crystalline rocks, are part of the proof that the crystallization of New England took place after the Coal Era. Fossils in Maine, Vermont, Canada,

* It is urged by Prof. Hall and others that the carboniferous beds in the west lie unconformably on the beds below. But the disturbance indicated was not one of bold flexures or uplifts.

and Massachusetts add to the evidence. The quiet required by the continent for the regular succession and undisturbed condition of the rocks of the Silurian, Devonian, and Carboniferous formations, shows that in neither of these ages could such vast results of metamorphic action and upheaval have taken place.

The length of time occupied by this revolution is beyond estimate. Every vestige of the ancient Carboniferous life of the continent disappeared before it. In Europe, a Permian Period passed, with its varied life; yet America, if we may trust negative evidence, still remained desolate. The Triassic Period next had its profusion of living beings in Europe, and over two thousand feet of rock; America through all, or till its latter portions, was still a blank: not till near the beginning of the Jurassic Period do we find any traces of new life, or even of another rock above the Carboniferous.

What better evidence could we have than the history of the oscillations of the surface from the earliest Silurian to the close of the Carboniferous Age, and the final cresting of the series in this Appalachian revolution, that the great features of the continent had been marked out from the earliest time? Even in the Azoic, the same northeast and southwest trend may be observed in northern New York and beyond Lake Superior, showing that, although the course of the great Azoic lands was partly east and west, the same system of dynamics that characterized succeeding ages was then to some extent apparent.

The first event in the records after the Appalachian revolution, was the gathering up of the sands and rolled fragments of the crystallized rocks and schists along the Atlantic border into beds; not over the whole surface, but in certain valleys, which lie parallel with the Appalachian chain, and which were evidently a result of the foldings of that revolution. The beds are the red sandstones and shales, which stretch on for one hundred and twenty miles in the Connecticut valley: and similar strata occur in southeastern New York, in New Jersey, Viginia, North Carolina and Nova Scotia. These long valleys are believed to have been estuaries, or else river courses.

The period of these deposits is regarded as the earlier Jurassic by Professor W. B. Rogers. Dr. Hitchcock supposes a portion of the preceding or Triassic Period to be represented.*

* This Red Sandstone, after being known for a while under the name of "Old Red Sandstone," was long called the "New Red Sandstone," it being

Many of the layers show, by their shrinkage cracks, ripple-marks, and footprints, as others have observed, that they were formed in shallow waters, or existed as exposed mud-flats. But they accumulated till they were over a thousand feet thick in Virginia, and in New England two or three thousand, according to the lowest estimate. Hence the land must have been sinking to a depth equal to this thickness, as the accumulation went on, since the layers were formed successively at or near the surface.

Is it not plain, then, that the oscillations, so active in the Appalachian revolution and actually constituting it, had not altogether ceased their movements, although the times were so quiet that numerous birds and reptiles were tenants of the Connecticut region? Is it not clear that these old valleys, occurring at intervals from Nova Scotia to South Carolina, originally made by foldings of the earth's crust, were still sinking?

And did not the tension below of the bending rocks finally cause ruptures? Even so: and the molten rock of the earth's interior which then escaped, through the crystalline rocks beneath and the overlying sandstone, constitutes the trap mountains, ridges, and dykes, thickly studding the Connecticut Valley,

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shown to be above the carboniferous system. The first step towards a nearer determination of its age was made by Mr. J. H. Redfield in a paper on the Fossil Fishes of the Connecticut valley published in 1836, who made it Jurassic (Lias or Oolitic,) (Ann. Lyc. N. Hist. N. Y., vol. iv.) Mr. W. C. Redfield added to the facts bearing on this conclusion through discoveries made in New Jersey and Virginia. Prof. W. B. Rogers deduced from the coal plants of the Richmond beds, the same age for those beds, while admitting that other beds of the sandstone might be Triassic. Afterwards on finding the same Posidonia and Cypridæ in North Carolina, in each of the beds in Virginia, in the belt in Pennsylvania near Phenixville, and one plant (Lycopodites Williamsonis) common to Virginia and Massachusetts, he suggested that all the beds were probably Jurassic (Am. J. Sci. [2,] xix, 123.) Mr. E. Hitchcock, Jr., detected recently a fossil plant (*Clathropteris rectiusculus*, Am. J. Sci. [2,] xx, 22,) near the middle of the sandstone formation in Massachusetts, and remarks that it indicates the existence of the Lower Jurassic at that place, and also renders it probable that the Triassic may be represented in the inferior beds, as is sustained by Prof. Hitchcock. Prof. Emmons has recently obtained Reptilian Fish, and Molluscan fossils in North Carolina, (communicated to the Amer. Assoc. at Albany in August last,) which are related to those of the Triassic and Jurassic periods. The amount of evidence as far as now understood therefore tends to sustain the view that the Period of the sandstone, while it may cover part of the Triassic, is mainly Jurassic.

standing in palisades along the Hudson, and diversifying the features of New Jersey and parts of Virginia and North Carolina. The trap is a singularly constant attendant on the sandstone, and everywhere bears evidence of having been thrown out soon after the deposition of the sandstone, or in connection with the formation of its later beds. Even the small sandstone region of Southbury in Connecticut, has its trap.

Thus ended in fire and violence, and probably in submergence beneath the sea, the quiet plains of the Connecticut valley, where lived, as we now believe, the first birds of creation; kinds that were nameless, until, some countless ages afterwards, President Hitchcock tracked them out, found evidence that they were no unworthy representatives of the feathered tribe, and gave them and their reptile associates befitting appelations.*

Such vast regions of eruptions could not have been without effusions of hot water and steam, and copious hot springs. And may not these heated waters and vapors, rising through the crystalline rocks below, have brought up the copper ores, that are now distributed, in some places, through the sandstone? The same cause, too, may have given the prevalent red color to the rock, and produced changes in the adjoining granite.

After the era of these rocks, there is no other American record during the European Jurassic Period.

In the next or Cretaceous Period, the seas once more abound in animal life. The position of the cretaceous beds around the Atlantic borders shows that the continent then stood above the sea very much as now, except at a lower level. The Mississippi valley, which, from the Silurian, had generally been the region of deeper waters, was even in cretaceous times occupied to a considerable extent by the sea,—the Mexican Gulf then reaching far north, even high up the Missouri, and covering also a considerable part of Texas and the Rocky Mountain slope.

An age later, the Cretaceous species had disappeared, and the Mammalian Age (or the Tertiary, its first Period) begins, with a wholly new Fauna, excepting, according to Professor Tuomey, some half a dozen species, about which however there is much doubt. The continent was not more elevated than in the preced-

* Mr. J. Deane of Greenfield was also an early explorer of these tracks, and is now engaged in publishing on the subject, illustrating his memoirs with plates of great beauty and perfection.

ing age, and the salt waters of the Mexican Gulf were withdrawn from the region of Iowa and Wisconsin, so as not to reach beyond the limits of Tennessee.*

Two or three times in the course of the Tertiary Period, the life of the seas was exterminated, so that the fossils of the later Tertiary are not identical with any in the earliest beds,—excluding some fish remains, species not confined to the coast waters. The crust of the earth was still oscillating; for the close of the first Tertiary epoch was a time of subsidence; but the oscillation or change of level was slight, and by the end of the Tertiary, the continent on the east stood within a few feet of its present elevation, while the Gulf of Mexico was reduced nearly to its present limits.†

I have thus brought this rapid sketch to the close of the Tertiary, having omitted much of great interest, in order to direct attention to the one grand fact,—that the continent from the Potsdam sandstone, or before, to the Upper Tertiary, was one in its progress,—a single consecutive series of events according to a common law. It is seen, that the great system of oscillations, due to force pressing or acting from the southeast, which reached its climax in the rise of the Appalachians, then commenced a decline. We mark the oscillations still producing great results

* The recent investigations of F. B. Meek and Dr. J. V. Hayden, have shown (Proc. Acad. Nat. Sci. Philad., viii, 111, 1856,) that while there is much *fresh-water* tertiary in the Nebraska regions and beyond, there is also about the head waters of the Missouri some *marine* tertiary. The region investigated lies between the 46th and 49th parallels of North latitude and the 100th and 108th degrees of longitude: but it is not yet ascertained whether the body of salt water thus indicated was an isolated area, or an arm from the Mexican Gulf. The shells, (species of Ostrea, Corbula, and Cerithium) do not satisfactorily fix the age of the tertiary, but suggest, the authors say, that it may be the older Eocene. They occur in the same beds with numerous freshwater shells, species of Melania, Physa, Paludina, Cyrena, and all are such kinds as inhabit fresh and brackish waters. The tertiary deposits of the Bad Lands, or that part where the bones occur, have afforded no evidence of salt water origin; and the same is true of the Lignite beds of the far north. While therefore the tertiary beds are extensive, the marine tertiary, indicating the presence of the sea, as far as present knowledge goes, is quite limited.

† Naming the North American Tertiary Epochs from prominent localities as in the Palæozoic, they are:—1. The Claiborne, or Older Eocene; 2. The Vicksburg, or Newer Eocene; 3. The Yorktown, or Pliocene and Miocene in one.

in the Jurassic Period along the whole eastern border from Nova Scotia to the Carolinas. Less effect appears in the Cretaceous Period; and gradually they almost die out as the Tertiary closes, leaving the Mississippi Valley and the eastern shores near their present level.

Thus were the great features of Middle and Eastern North America evolved; nearly all its grand physical events, including its devastations and the alternations in its rocks, were consequent upon this system of development. Moreover, as I have observed, this system was some way connected with the relative position of the continent and the oceanic basin.

We need yet more definite knowledge of the Pacific border of North America to complete this subject. It is in accordance with the fact that the highest mountains are there, that volcanoes have been there in action; and also that, in the Tertiary Period, elevations of one to two thousand feet took place; and that immediately before the Tertiary, a still greater elevation of the Rocky Mountains across from east to west occurred. The system of changes between the Rocky Mountains and the Pacific has been on a grander scale than on the Atlantic border, and also from a different direction,—and this last is an element for whose influence on the general features we cannot yet make full allowance.

Through all this time, central British America appears to have taken little part in the operations; and what changes there were, except it may be, in the Arctic regions, conformed to the system prevailing farther south, for the rocks of the Jurassic Age, like the Connecticut River sandstone, are found as far north as Prince Edward's Island, in the Gulf of St. Lawrence.

But the Tertiary Period does not close the history of the continent. There is another long Period the Post-tertiary,—the period of the Drift, of the Mastodon and Elephant, of the lake and river terraces, of the marine beds on Lake Champlain and the St. Lawrence,—all anterior to the Human Era.

From this time there is a fundamental change in the course of operations. The oscillations are from the north, and no longer from the southeast.

The *drift* is the first great event, as it underlies the other loose material of the surface; and all recognize it as a *northern* phenomenon, connected with northern oscillations.

The upper terrace of the lakes and rivers, and also the marine beds four hundred feet above the level of Lake Champlain, and five hundred above the St. Lawrence, which have been called Laurentian deposits, are marks of a *northern* depression, as no one denies.

The subsequent elevation to the present level again, by stages marked in the lower river terraces, was also *northern*, affecting the region before depressed.

The south felt but slightly these oscillations.

There are thus the following epochs in the Post-tertiary :—the *Drift Epoch ;* the *Laurentian Epoch*, an epoch of depression ; the *Terrace Epoch*, an epoch of elevation ; *three* in number, unless the Drift and Laurentian Epochs are one and the same.

As this particular point is one of much interest in American Geology, I will briefly review some of the facts connected with the drift.

The drift was one of the most stupendous events in geological history. In some way, by a cause as wide as the continent,—and, I may say, as wide nearly as the world,—stones of all sizes, to immense boulders of one or two thousand tons weight, were transported, along with gravel and sand, over hills and valleys, deeply scratching the rocks across which they travelled. Although the ocean had full play in the many earlier ages, and an uneasy earth at times must have produced great convulsions, in no rock strata, from the first to the last, do we find imbedded stones or boulders at all comparable in magnitude with the immense blocks that were lifted and borne along for miles in the Drift epoch.

Much doubt must remain about the origin of the drift, until the courses of the stones and scratches about mountain ridges and valleys shall have been exactly ascertained. The general course from the north is admitted ; but the special facts proving or disproving a degree of dependence on the configuration of the land have not yet been sufficiently studied.

One theory, the most prevalent, supposes a deep submergence over New England and the north and west, even to a depth of four or five thousand feet, and conceives of icebergs as floating along the blocks of stone, and at bottom scratching the rocks. Another, that of the Professors Rogers, objects to such a submergence, and attributes the result to an incursion of the ocean

from the north, in consequence of an earthquake movement beneath the Arctic Seas.

The idea of a submergence is objected to on the ground that the sea has left no proof of its presence by fossils, sea shore terraces or beaches.

Unless the whole continent were submerged, of which there is no evidence whatever, there must have been in the Post-tertiary Period an east-and-west line of sea-shore, say across New Jersey, Pennsylvania, Southern Ohio, and the other States west, or still farther south; and yet no such sea-shore marks now exist to trace its outline, although the ocean must have been a portion of the same that had laid up the Cretaceous and Tertiary beds along the coasts, and, in fact, already contained the oysters and clams and many other species of Mollusks which now exist. Can it be, that, contrary to all the ways of the past, such a grand submergence as this view supposes, placing New England four thousand feet under water, could have transpired without a sea-shore record?

Very many have replied in the affirmative; and one able advocate of this view, who sees no difficulty in the total absence of sea-shore terraces or fossils at all levels above the Laurentian beds, finds in the succeeding epoch sea-shore accumulations in all the terraces of our rivers. Why this wonderful contrast? What withheld the waves from acting like waves in the former case, and gave unbounded licence in the latter?

This much, then, seems plain, that the evidence although negative, is very much like positive proof that the land was not beneath the sea to the extent the explanation of the drift phenomena would require.

There are other objections to this view of submergence. If North America were submerged from the southern boundary-line of the drift far into the Arctic regions, this would have made a much warmer climate for the continent than now; if only half-way, then there is another east-and-west shore line to be traced out, before the fact of the submergence can be admitted. Again, we know how the ice, while a glacier, or along a shore of cliffs, (for all bergs are believed to have once been glaciers,) may receive upon them or gather up heavy blocks of stone, even a thousand tons in weight, and bear them off to distant regions, as now happens in the Northern Atlantic. But we have no reason to believe that the massy foot of a berg could pick up such blocks

and carry them twenty miles, to drop them again : and hence the short distance of travel would prove that the bergs were made that short distance to the north, and this implies the existence there of glacier valleys and requires a glacier theory.

But without considering other difficulties, I pass to the inquiry Whether the lands, if not submerged, were at any higher level than now ?

There is evidence of striking character, that the regions or coasts over the higher latitudes, in both the northern and southern hemispheres, were once much elevated above their present condition. The *fiords*, or deep coast channels, scores of miles long, that cut up the coast of Norway and Britain, of Maine, Nova Scotia and Greenland, of Western America from Puget's Sound north, of southern South America from Chiloe south, of Van Diemen's Land and other southern islands, are all valleys that could not have been scooped out when filled with the ocean's waters as now ; that could have been formed only when the land in those high latitudes, north and south, was elevated till their profound depths were nearly or quite dry. Whether this elevation was in the period of the Post-tertiary has not been precisely ascertained. But as they are proof of a north-and-south system of oscillations, the same that was in action in the Drift epoch, and as the cold that such a change would occasion is not very distinctly apparent in the Tertiary period, and much less in the earlier, we have reason for referrring the greater part of the elevation to that drift era and for believing that the excavation of these fiord valleys was then in progress. Both fiords and drift are alike high-latitude phenomena on all the continents north and south. The change of climate between the Cretaceous and Tertiary, and the absence of Tertiary beds north of Cape Cod, may have been connected with an incipent stage in this high latitude movement.

However this be, there is other evidence in the cold of the Drift period, of some extraordinary cause of cold. The drift in Europe and Britain is generally attributed to glaciers and icebergs during a period of greater cold than now ; and the fact of this greater cold is so generally admitted, that it is common to speak of it as the glacial period. Professor Agassiz, moreover has urged for this continent the glacial theory.

In a memoir of great research by Mr. Hopkins of Cambridge, England, the able author maintains that this glacial cold might

have been produced over Europe, partly at least, by a diversion of the Gulf Stream from its present position. He seems in his paper to attribute too much effect to the Gulf Stream, and too little to the prevailing currents of the atmosphere. But, setting this aside, it is unfortunate for the hypothesis, that there is no reason to suppose that America was not then as much in the way of such a diversion as now. The small changes of level which the Tertiary and Post-tertiary beds of the Gulf have undergone, prove that the gate of Darien was early closed, and has since continued closed. America, as facts show, has not been submerged since the Tertiary to receive the stream over its surface. If it had been, it would have given other limits to her own drift phenomena; for it is an important fact that these limits in America and Europe show the very same difference in the climates or in the isothermals as that which now exists.*

On the question of the drift, we therefore seem to be forced to conclude, whatever the difficulties we may encounter from the conclusion, that the continent was not submerged, and therefore that icebergs could not have been the main drift agents: that the period was a cold or glacial epoch, and the increase of cold was probably produced by an increase in the extent and elevation of northern lands. Further than this, in the explanation of the drift, known facts hardly warrant our going.

If, then, the Drift epoch was a period of elevation, it must have been followed by a deep submergence to bring about the depression of the continent already alluded to, when the ocean stood four hundred feet deep in Lake Champlain, and a whale—for his bones have been found by the Rev. Z. Thompson of Burlington—was actually stranded on its shores; and when the upper terraces of the rivers was the lower river flat of the valleys. This submergence, judging from the elevated sea-beaches and terraces, was five hundred feet on the St. Lawrence and Lake Champlian; eighty feet at Augusta, Maine; fifty feet at Lubec; thirty at

* Moreover, the Gulf Stream is known to be a deep current, so deep as to be turned around to the northward in part by the submarine slopes of the outer West Indian Islands, and it would have required a submergence of many hundred feet, and moreover a passage quite across the continent into the Arctic seas, to have given the stream a chance over the land: and even then, if the West Indian Islands were not also deeply sunk in the ocean a large part of the current would still have kept its present track in the Atlantic.

Sancoti Head, Nantucket; over one hundred at Brooklyn, N. Y.; and two hundred to two hundred and fifty in Central New England, just north of Massachusetts; while south, in South Carolina, it was but eight or ten feet.

But whence the waters to flood valleys so wide, and produce the great alluvial plain constituting the upper terrace, so immensely beyond the capability of the present streams? Perhaps as has been suggested for the other continent, and by Agassiz for this, from the melting snows of the declining glacier epoch.

The frequent absence of fine stratification, so common in the material of this upper terrace, has often been attributed to a glacier origin.

According to this view, the events of the Post-tertiary Period in this country make a single consecutive series, dependent mainly on polar or high-latitude oscillations:—an elevation for the *first* or *Glacial Epoch;* a depression for the *second* or *Laurentian Epoch;* a moderate elevation again, to the present height, for the *third* or *Terrace Epoch.*

The same system may, I believe, be detected in Europe; but, like all the geology of that continent, it is complicated by many conflicting results and local exceptions; while North America, as I have said, is like a single unfolding flower in its system of evolutions.

There is the grandeur of nature in the simplicity to which we thus reduce the historical progress of this continent. The prolonged oscillations of the crust, caused by pressure from the southeast beneath the Atlantic, which reach on through the Palæozoic ages, producing the many changes of level in the Silurian and Devonian, still others of greater frequency in the Carboniferous, and then, as in an outburst of long emprisoned energy, throwing up the range of the Appalachians, with vast effusions of heat through the racked and tortured crust, next go on declining as the Jurassic and Cretaceous Periods pass, and finally fade out in the Tertiary. The northern oscillations, perhaps before in progress, then begin to exhibit their effects over the high temperate latitudes, and continue to the Human Era. The sinking of Greenland, now going on, may be another turn in the movement; and it is a significant fact, that, while we have both there and in Sweden northern changes of level in progress, such great secular movements have nowhere been detected on the tropical parts of the continents.

In deducing these conclusions, I have only stated in order the facts as developed by our geologists. Were there time for a more minute survey of details, the results would stand forth in bolder characters.

The sublimity of these continental movements is greatly enhanced when we extend our vision beyond this continent to other parts of the world. It can be no fortunate coincidence, that has produced the parallelism between the Appalachian system and the grand feature lines of Britain, Norway, and Brazil, or that has covered the north and south alike with drift and fiords. But I will not wander, although the field of study is a tempting one.

In thus tracing out the fact, that there has been a plan or system of development in the history of this planet, do we separate the Infinite Creator from his works? Far from it: no more than in tracing the history of a plant. We but study the method in which Boundless Wisdom has chosen to act in creation For we cannot conceive that to act without plan or order is either a mark of divinity or wisdom. Assuredly it is far from the method of the God of the universe, who has filled all nature with harmonies; and who has exhibited his will and exalted purpose as much in the formation of a continent, to all its details, as in the ordered evolution of a human being. And if man, from studying physical nature, begins to see only a Deity of physical attributes, of mere power and mathematics, he has but to look within at the combination of the affections with intellect, and observe the latter reaching its highest exaltation when the former are supreme, to discover proofs that the highest glory of the Creator consists in the infinitude of his love.

My plan, laid out in view of the limited time of a single address, has led me to pass in silence many points that seem to demand attention or criticism; and also to leave unnoticed the labors of many successful investigators.

There are some subjects, however, which bear on general geology, that should pass in brief review.

I. The rock-formations in America may in general be shown to be synchronous approximately with beds in the European series But it is more difficult to prove that castastrophes were synchronous, that is, revolutions limiting the ages or periods.

The revolution closing the Azoic Age, the *first* we distinctly observe in America, was probably nearly universal over the globe.

An epoch of some disturbance between the Lower and Upper Silurian is recognized on both continents. Yet it was less complete in the destruction of life on Europe than here, more species there surviving the catastrophe; and in this country there was but little displacement of the rocks.

The Silurian and the Devonian Ages each closed in America with no greater revolutions than those minor movements which divided the subordinate periods in those ages. Prof. Hall observes that they blend with one another, and the latter also with the Carboniferous, and that there is no proof of contemporaneous catastrophes giving them like limits here and in Europe.

But after the Carboniferous, came the Appalachian revolution, one of the most general periods of catastrophe and metamorphism in the earth's history. Yet in Europe the disturbances were far less general than with us, and occured along at the beginning and end of the Permian Period.

From this epoch to the close of the Cretaceous, there were no contemporaneous revolutions, as far as we can discover. But the Cretaceous Period terminates in an epoch of catastrophe which was the most universal on record, all foreign Cretaceous species having been exterminated, and all American, with a few doubtful exceptions.* This third general revolution was the prelude to the Mammalian Age. But there is no time to do this subject justice, and I pass on,—merely adding, on account of its interest to those who would understand the first chapter of Genesis, that there is no evidence whatever in Geology, that the earth, after its completion; passed through a chaos and a six day's creation at the epoch immediately preceding man, as Buckland, in the younger days of the science, suggested, on *Biblical*, not on Geological, ground. No one pretends that there is a fact or hint in Geology to sustain such an idea; on the contrary, it is utterly opposed to it.

II. The question of the existence of a distinct *Cambrian system* is decided adversely by the American records. The Mollusca in all their grand divisions appear in the subdivisions of the Lower as well as Upper Silurian, and the whole is equally and alike the Molluscan or Silurian Age. The term Cambrian, therefore, if used for fossiliferous strata, must be made subordinate to Silurian.

* This catastrophe may not have been violent; it may have been ages in accomplishment; yet it was disastrous to the living tribes over the whole sphere.

The *Taconic system* of Emmons has been supposed by its author to have a place inferior to the Cambrian of Sedgwick, or else on a level with it. But the investigations of Hall, Mather and Rogers, and more lately of Logan and Hunt, have shown that the Taconic slates belong with the upper part of the Lower Silurian, being, in fact, the Hudson River shales, far from the bottom of the sca..

III. The American rocks throw much light on the origin of coal. Professor Henry D. Rogers, in an able paper on the American coal-fields, has well shown that the condition of a delta or estuary for the growth of the coal-plants, admitted even now by some eminent geologists, is out of the question, unless the whole continent may be so called; for a large part of its surface was covered with the vegetation. Deltas exist where there are large rivers; and such rivers accumulate and flow where there are mountains. How, then, could there have been rivers, or true deltas of much size, in the Coal Period, before the Rocky Mountains or Appalachians were raised? It takes the Andes to make an Amazon. This remark has a wider application than simply to the Coal Era.

IV. In this connection, I add a word on the idea that the rocks of our continent have been supplied with sands and gravel from a continent now sunk in the ocean. No facts prove that such a continent has ever existed, and the whole system of progress, as I have explained, is opposed to it. Moreover, gravel and sands are never drifted away from sea-shores, except by the very largest of rivers, like the Amazon; and with these, only part of the lightest or finest detritus is carried far away; for much the larger part is returned to the coast through tidal action, which has a propelling movement shoreward, where there are soundings. The existence of an Amazon on any such Atlantic continent in Silurian, Devonian, or Carboniferous times, is too wild an hypothesis for a moment's indulgence.

V. The bearings of the facts in American Palæontology on the science, might well occupy another full discourse. I will close with brief allusions to some points of general interest.

1. The change in the Fauna of the globe as the Age of Man approaches, is one of the most interesting facts in the earth's history. It was a change not in the types of the races, (for each continent retains its characteristic,) but a remarkable dwindling in the size of species. In North America the Buffalo became

the successor to the huge Mastodon, Elephant, and the Bootherium; the small Beaver to the great Castoroides; and the existing Carnivora are all comparatively small.

Parallel with this fact, we find that in South America, as Dr. Lund observes, where, in the last age before Man, there were the giant Megatherium and Glyptodon, and other related Edentates, there are now the small Sloths, Armadillos, and Anteaters.

So, also, on the Oriental continent, the gigantic Lion, Tiger, Hyena, and Elephant, and other monster quadrupeds, have now their very inferior representatives.

In New Holland, too, the land of Marsupials, there are Marsupials still, but of less magnitude.

2. This American continent has contributed to science a knowedge of some of the earliest traces of Reptiles,—the species of the Pennsylvania coal formation, described by Mr. King and Mr. Lea, and others from the Nova Scotia coal-fields, discovered by Messrs. Dawson and Lyell.

It has afforded the earliest traces of birds thus far deciphered in geological history,—the colossal and smaller waders, whose tracks cover the clayey layers and sandstone of the Jurassic rocks in the Connecticut valley. The earliest Cetacea yet known are from he American Cretaceous beds, as described by Dr. Leidly. And among the large Mammals which had had posession of the renewed world after the Cretaceous life had been swept away, the largest, as far as has been ascertained, lived on this continent. The Palæotheria of the Paris Basin, described by Cuvier, were but half the size of the allied Titanotheria of Nebraska.

But here our boasting ceases, for, as Agassiz has shown, the present Fauna of America is more analogous to the later Tertiary of Europe than to the existing species of that continent.

In the Palæozoic Ages, to the close of the Coal Period, the American continent was as brilliant and perhaps as profuse in its life as any other part of the world. It was a period, indeed, when the globe was in an important sense a unit, not individualized in its climates or its distribution of life, and only partially in its seas. But from this time the contrast is most striking.

The whole number of known American species of animals of the Permian, Triassic, Jurassic Cretaceous, and Tertiary Periods is about two thousand; while in Britain and Europe, a territory even smaller, there were over twenty thousand species. In the Permian we have *none*, while Europe has over two hundred species.

In the Triassic, *none;* Europe, one thousand species. In the Jurassic, (the supposed Triassic here included) sixty; Europe, over four thousand. In the Cretaceous, three hundred and fifty to four hundred: Europe, five to six thousand. In the Tertiary, hardly fifteen hundred; Europe, about eight thousand.

America, since Palæozoic times, has therefore been eminent for the poverty of its Fauna.

Again: the Mammalian Age in America, although commencing with huge Pachyderms, shows little progress afterward. The larger quadrupeds continue to be mostly herbivorous, and the Carnivora, the higher group, are few and of comparatively small size. *The Herbivora are still the typical species.* While in Europe and Asia, at the same time,—that is, in the Post-tertiary,—the Carnivora are of great size and ferocity, far exceeding the largest of modern Lions and Tigers, and they exist in immense numbers. The single species of Lion described by Dr. Leidy, from a bone from near Natchez, hardly lessens the contrast.

South America, as has been remarked by Agassiz and others, sustains the inferior position of America. The huge Sloths, Megatheria, and other Edentates of the South, are even lower in grade than the ordinary Herbivora, and place that Southern continent at an inferior level in the scale. Although there were Carnivora, they were much smaller than the European. *The Edentates are its typical species.*

The supremacy of the great Oriental continent is, therefore, most signally apparent.

The contrast is still greater with Australia and New Zealand, whose past and present Fauna and Flora have been well said by Agassiz and Owen to represent the Jurassic Period,—the present era affording Trigonias, Terebratulæ, Cestraciont Fishes, and the Araucarian Coniferæ, all Jurassic types, besides Kangaroos and Moas. Among Mammals, as is well known, *the Marsupials,* the lowest of all in the class, *are its typical species.*

Ever since Palæozoic times, therefore, the Oriental Continent,—that is Europe, Asia, and Africa combined,—has taken the lead in animal life. Through the Reptilian Age, Europe and Asia had species by thousands, while America was almost untenanted. In the later Mammalian Age, North America was yet in the shade, both in its Mammals and lower tribes; South America in still darker shadows; and Australia even deeper still. The earth's antipodes were like light and darkness in their zoolo-

gical contrasts. And was there not in all this a prophetic indication, which had long been growing more and more distinct, that the Eastern Continent would be man's chosen birthplace? that the long series of living beings, which had been in slow progression through incalculable ages, would there at last attain its highest exaltation? that the stupendous system of nature would there be opened to its fullest expansion?

Another of our number has shown in eloquent language how the diversified features and productions of the Old World conspired to adapt it for the childhood and development of the race; and that, when beyond his pupilage, having accomplished his rescue from himself and the tyranny of forces around him, and broken the elements into his service, he needed to emerge from the trammels of the school-house in order to enjoy his fullest freedom of thought and action, and social union. Professor Guyot observes farther, that America, ever free, was the appointed land for this freedom and union,—of which its open plains, and oneness of structure, were a fit emblem; and that, although long without signs of progress or hope in its future, this land is to be centre of hope and light to the world.

In view of all these arrangements, man may well feel exalted. He is the last of the grand series. At his approach, the fierce tribes of the earth drew back, and the race dwindled to one-fourth its bulk and ferocity,—the huge Mastodons, Lions, and Hyenas yielding place to other species, better fit to be his attendants, and more in harmony with the new creation. Partaking of the Divine image, all nature pays him tribute; the universe is his field of study; an eternity his future. Surely it is a high eminence on which he stands.

Yet he is only *one* of the series; one individuality in the vast system. How vain the philosophy which makes the creature the God of nature, or nature its own author! Infinitely beyond man, infinitely beyond all created things, is that Being with whom this system, and the combined systems of immensity, were as one purpose of His will.*

* This Address, exclusive of the notes, is cited from the Proceedings of the Amer. Assoc. IXth Meeting at Providence, R. I. It was delivered by the author on retiring from the duties of President.

ARTICLE LVII.—*On the several species of Squirrels inhabiting the British Provinces.*

Description of the Genus.

GENUS SCIURUS.—Linn., Erxleb., Cuv., Geoff., Illiger.

Dental Formula.

Incisive, $\frac{2}{2}$; *Canine*, $\frac{0}{0}$—$\frac{0}{0}$; *Molar* $\frac{4}{4}$—$\frac{4}{4}$ or $\frac{5}{4}$—$\frac{5}{4}$ = 20 or 22.

Body elongated; tail long and furnished with hairs; head large; ears erect; eyes projecting and brilliant; upper lip divided. Four toes before, with a tubercle covered by a blunt nail; five toes behind. The four grinders, on each side the mouth above and beneath, are variously tuberculated; a very small additional one in front, above, is in some species permanent, but in most cases drops out when the young have attained the age of from six to twelve weeks. Mammæ, eight; two pectoral, the others abdominal.

The squirrel is admirably adapted to a residence on trees, for which nature has designed it. Its fingers are long, slender and deeply cleft, and its nails very acute and greatly compressed; it is enabled to leap from branch to branch, and from tree to tree, clinging to the smallest twigs, and seldom missing its hold. When this happens to be the case, it has an instinctive habit of grasping in its descent at the first object which may present itself, or if about to fall to the earth, it spreads itself out in the manner of the flying squirrel, and thus by presenting a greater resistance to the air, is enabled to reach the ground without injury, and recover itself so instantaneously, that it often escapes the teeth of the dog that watches its descent, and stands ready to seize upon it at the moment of its fall. It immediately ascends a neighbouring tree, emitting very frequently a querulous bark, which is either a note of fear or of triumph.

Although the squirrel moves with considerable activity on the ground, it rather runs than leaps; on trees, however, its activity and agility are surprising, and it is generally able to escape from its enemies, and conceal itself in a few moments, either among the thick foliage, in its nest, or in a hollow tree. The squirrel usually conveys its food to the mouth by the fore-paws. Nuts, and seeds of all kinds, are held by it between the rudimental thumbs and the inner portions of the palms. When disturbed or alarmed, it either drops the nut and makes a rapid retreat, or seizes it with the incisors, and carries it to its hole or nest.

All our American species of this genus, as far as we have been able to become acquainted with their habits, build their nests either in the fork of a tree, or on some secure portion of its branches. The nest is hemispherical in shape, and is composed of sticks, leaves, the bark of trees, and various kinds of mosses and lichens. In the vicinity of these nests, however, they have a still more secure retreat in some hollow tree, to which they retire in cold or in very wet weather, and where their first litter of young is generally produced.

Several species of squirrels collect and hide away food during the abundant season of autumn, to serve as a winter store. This hoard is composed of various kinds of walnuts and hickory nuts, chesnuts, chinquepins, acorns, corn, &c., which may be found in their vicinity. The species, however, that inhabit the Southern portions of the United States, where the ground is seldom covered with snow, and where they can always derive a precarious support from the seeds, insects, and worms, which they scratch up among the leaves, &c., are less provident in this respect; and of all our species, the chickaree, or Hudson's Bay squirrel (Sc. *Hudsonius*) is by far the most industrious, and lays up the greatest quantity of food.

In the spring, the squirrels shed their hair, which is replaced by a thinner and less furry coat; during summer their tails are narrower and less feathery than in autumn, when they either receive an entirely new coat, or a very great accession of fur; at this season also, the outer surfaces of the ears are more thickly and prominently clothed with fur than in the spring and summer.

Squirrels are notorious depredators on the Indian corn fields of the farmer, in some portions of our country, consuming great quantities of this grain, and by tearing off the husks, exposing an immense number of the unripe ears to the mouldering influence of the dew and rain.

The usual note emitted by this genus is a kind of tremulous querulous bark, not very unlike the quacking of a duck. Although all our larger squirrels have shades of difference in their notes, which will enable the practised ear to designate the species even before they are seen, yet this difference cannot easily be described by words. Their bark seems to be the repetition of a syllable five or six times, quack-quack-quack-quack-qua—commencing low, gradually raising to a higher pitch, and ending with a drawl on the last letter in the syllable. The notes, however, of the smaller

Hudson's Bay squirrel, and its kindred species existing on the Rocky Mountains, differ considerably from those of the larger squirrels; they are sharper, more rapidly uttered, and of longer continuance; seeming intermediate between the bark of the latter and the chipping calls of the ground-squirrels, (TAMIAS.) The barking of the squirrel may be heard occasionally in the forest during all hours of the day, but is uttered most frequently in the morning and afternoon. Any sudden noise in the woods, or the distant report of a gun, is almost certain, during fine weather, to be succeeded by the barking of the squirrel. This is either a note of playfulness or of love. Whilst barking it seats itself for a few moments on a branch of a tree, elevates its tail over its back towards the head, and bending the point backwards continues to jerk its body, and elevate and depress the tail at the repetition of each successive note. Like the mocking bird and the nightingale, however, the squirrel, very soon after he begins to sing, (for to his own ear, at least, his voice must be musical,) also commences skipping and dancing; he leaps playfully from bough to bough, sometimes pursuing a rival or his mate for a few moments, and then reiterating with renewed vigour his querulous and monotonous notes.

One of the most common habits of the squirrel is that of dodging around the tree when approached, and keeping on the opposite side, so as to completely baffle the hunter who is alone. Hence it is almost essential to the sportsman's success, that he should be accompanied by a second person, who, by walking slowly round the tree on which the squirrel has been seen, and beating the bushes, and making a good deal of noise, causes him to move to the side where the gunner is silently stationed, waiting for a view of him to fire. When a squirrel is seated on a branch, and fancies himself undiscovered, should some one approach, he immediately depresses his tail, and extending it along the branch behind him, presses his body so closely to the bark, that he frequently escapes the most practised eye. Notwithstanding the agility of these animals, man is not their only, nor even their most formidable enemy. The owl makes a frequent meal of those species which continue to seek their food late in the evening and early in the morning. Several species of hawks, especially the red-tailed, (*Buteo borealis,*) and the red-shouldered, (*Buteo lineatus,*) pounce upon them by day. The black snake, rattle snake, and other species of snakes, can secure them; and the ermine, the

fox, and the wild cat, are incessantly exerting their sagacity in lessening their numbers.

The generic name Sciurus is derived from the Latin *sciurus*, a squirrel, and from the Greek *skiouros*, from *skia*, a shade, and *oura*, a tail.

There are between sixty and seventy species of this genus known to authors; about twenty well determined species exist in North America. (*Aud & Bach.*)

There are only three species of the above described genus known in Canada, namely the Red Squirrel, *Sciurus Hudsonius*, the Black Squirrel, *Sciurus niger*, and the northern Gray Squirrel, *Sciurus migratorius*. We mean by the above, that only these three of our small quadrupeds properly belong to the group, technically designated by the generic name here given. There are others, such as the small striped Squirrel or Chip Muck and the Flying Squirrel, which, although closely related to *Sciurus* proper, and bearing the same common name, yet are considered sufficiently distinct to be otherwise classified. The former is therefore placed in the genus Tamias, and the latter in that of Pteromys, both of which we shall have occasion to describe hereafter.

The Gray Squirrel.

The Gray Squirrel *Sciurus migratorius*, is about twenty-two inches in length, the body being twelve inches, and the tail without the long terminal hairs ten. The colour varies greatly, but in general, the true grey variety has the sides neck and hips light gray, the nose, cheeks, a space round the eyes, the upper surface of the feet, and a stripe along the sides, yellowish brown. On the back, there is an obscure stripe of brown. The hairs for one half of their length at base are dark cinerous, then a narrow mark of black, and are tipped with white. There is a variety which has the whole upper surface dark brownish black. It is often found in the same nest which contains the family of the gray parents.

This species constructs its nest of small branches, twigs, leaves and moss, in the fork of a tree, or in some convenient place upon a large branch. The materials are not sought upon the ground, but in the tree top, where both male and female employ themselves actively all day long, breaking off the dry twigs, and even gnawing through the small green branches. The young are brought forth in May or June, and soon attain sufficient size and strength to

leave the nest. The whole of the young family may be often seen clinging around or playing about the same tree, and when alarmed, all run into some small hole and disappear; sometimes one may be seen with his head at the hole curiously watching the intruder upon their sports.

The Gray Squirrel it is said does not lay up a hoard of winter provisions. It is known to feed on the larvae of various species of insects, but its principal food consists of nuts, seeds and grain. The hard shell of the hickory nut affords no protection to the embryo tree within, against the sharp incisors of this squirrel. The animal first gnaws off the thick pericarp of the nut and then makes a small hole in the thinnest part of the shell immediately over the kernel, through which it is all completely extracted. This is performed in an incredibly short space of time, and one squirrel will soon destroy what in course of time might have grown into a forest of some acres in extent. It is particularly fond of young Indian corn, and squirrel hunts got up by the farmers in retaliation are too well known to need any description here.

The enemies of this species are the fox, weasel, lynx, red tailed hawk, &c. The latter, when unaccompanied by his mate, finds it no easy undertaking to accomplish the capture, as the nimble squirrel twists and dodges around the tree or large branch so quickly that the hawk, after an hour's baffling, is forced to retire from sheer exhaustion. It is said, however, that these birds sometimes hunt in couples, and then the squirrel falls an easy prey, as in dodging away from one of his pursuers he often springs within reach of the talons of the other. This animal is remarkable for the extent of its migrations, which appear to have been more frequent in former times than at present.

Audubon says, "the farmers in the Western wilds regard them with sensations which may be compared to the anxious apprehensions of the Eastern nations at the flight of the devouring locust. At such periods, which usually occur in autumn, the squirrels congregate in different districts of the far North-west; and in irregular troops make their way instinctively in an eastern direction. Mountains, cleared fields, the narrow bays of some of our lakes, or our broad rivers, present no unconquerable impediments. Onward they come, devouring on their way every thing that is suited to their taste, laying waste the corn and wheat-fields of the farmer; and as their numbers are thinned by the gun, the dog,

and the club, others fall in and fill up the ranks, till they occasion infinite mischief, and call forth more than empty threats of vengeance. It is often inquired, how these little creatures, that on common occasion have such an instinctive dread of water, are enabled to cross broad and rapid rivers, like the Ohio and Hudson for instance. It has been asserted by authors, and is believed by many, that they carry to the shore a suitable piece of bark, and seizing the opportunity of a favourable breeze, seat themselves upon this substitute for a boat, hoist their broad tails as a sail, and float safely to the opposite shore. This, together with many other traits of intelligence ascribed to this species, we suspect to be apocryphal. That they do migrate at irregular, and occasionally at distant periods, is a fact sufficiently established; but in the only two instances in which we had opportunities of witnessing the migrations of these squirrels, it appeared to us, that they were not only unskilful sailors but clumsy swimmers. One of these occasions, (as far as our recollection serves us) was in the autumn of 1808 or 1809; troops of squirrels suddenly and unexpectedly made their appearance in the neighbourhood; among them were varieties not previously seen in those parts; some were broadly striped with yellow on the sides, and a few had a black stripe on each side, bordered with yellow or brown, resembling the stripes on the sides of the Hudson's Bay squirrel, (*S. Hudsonius.*) They swam the Hudson in various places between Waterford and Saratoga; those which we observed crossing the river were swimming deep and awkwardly, their bodies and tails wholly submerged; several that had been drowned were carried downwards by the stream, and those which were so fortunate as to reach the opposite bank were so wet and fatigued, that the boys stationed there with clubs found no difficulty in securing them alive or in killing them. Their migrations on that occasion did not, as far as we could learn, extend farther eastward than the mountains of Vermont; many remained in the county of Rensselaer, and it was remarked that for several years afterwards squirrels were far more numerous there than before. It is doubtful whether any ever return to the west, as finding forests and food suited to their taste and habits, they take up their permanent residence in their newly explored country, where they remain and propagate their species, until they are gradually thinned off by the increase of inhabitants, new clearings, and the dexterity of the sportsmen around them. The other instance occurred in 1819, when we were descending

the Ohio river in a flat-boat, or ark, chiefly with the intention of seeking for birds then unknown to us. About one hundred miles below Cincinnati, as we were floating down the stream, we observed a large number of squirrels swimming across the river, and we continued to see them at various places, until we had nearly reached Smithland, a town not more than about one hundred miles above the mouth of the Ohio.

At times they were strewed, as it were, over the surface of the water, and some of them being fatigued sought a few moments' rest on our long "steering oar," which hung into the water in a slanting direction over the stern of our boat. The boys, along the shores and in boats were killing the squirrels with clubs in great numbers, although most of them got safe across. After they had reached the shore, we saw some of them trimming their fur on the fences or on logs of drift-wood.

We kept some of these squirrels alive; they were fed with hickory nuts, pecans, and ground or pea-nuts, (*Arachis hypogæa.*) Immediately after eating as much as sufficed for a meal, they hid away the remainder beneath the straw and cotton at the bottom of their cage in a little heap. A very tame and gentle one we had in a room at Shippingport, near Louisville, Kentucky, one night ate its way into a bureau, in which we had a quantity of arsenic in powder, and died next morning a victim to curiosity or appetite, probably the latter, for the bureau also contained some wheat.

Geographical Distribution. — Occurs as far north as the Hudson's Bay; in Upper Canada, along the St. Lawrence and westward. Never seen in the valley of the Ottawa; does not exist in Lower Canada nor in the Southern States, nor as far west as the Rocky Mountains.

THE BLACK SQUIRREL.

Sciurus Niger.—*Linn.*

"Head a little shorter and more arched than that of the Northern gray squirrel; incisors compressed, strong, and of a deep orange colour anteriorly; ears elliptical and slightly rounded at the tip, thickly clothed with fur on both surfaces, the fur on the outer surface extending three lines beyond the margin; there are, however, no distinct tufts; whiskers a little longer than the head; tail long, not very distichous, thickly clothed with moderately close hair; the fur is softer than that of the Northern

gray squirrel;" colour black, with a few white tufts of hair interspersed.

This species is found all along the St. Lawrence and great lakes, but only occasionally in the valley of the Ottawa. It does not occur in Lower Canada, Nova Scotia or New Brunswick. There appears to be some doubt as to the extent of territory west of the lakes, over which the range of this squirrel extends, some authors having confused the subject by describing animals as occurring in various places in the west, which cannot be distinguished by the descriptions from the black variety of the gray squirrel. The habits do not appear to be different from those of *S. Migratorius*, and it is a somewhat larger species.

The black squirrel was unknown in the neighbourhood of the City of Ottawa for more than thirty years after the place became inhabited by the white men, and although of late a few are seen every year, yet still they cannot be said to have regularly established themselves in that thriving quarter. It appears to us, that it is to the settlement of the tract of country lying between the St. Lawrence and the Ottawa that the appearance of this species upon the banks of the latter stream must be attributed. In Western Canada they are at times exceedingly numerous.

THE RED SQUIRREL.

SCIURUS HUDSONIUS.—*Pennant.*

This species is a third smaller than the gray squirrel, tail shorter than the body, ears slightly tufted, colour, reddish above, white beneath. It has only four molar teeth in the upper jaw on each side, while many of the other species have five. The forehead is slightly arched; the nose obtuse; eyes of moderate size; ears, broad rounded, clothed on both sides with short hairs, not distinctly tufted like those of the European squirrel, to which it has been referred, although the hairs when the animal has its winter pelage, project beyond the margins and resemble tufts; whiskers a little longer than the head, the body presents the appearances of lightness and agility; the tail is somewhat depressed, and linear, not as bushy as in most other squirrels, but capable of a distichious arrangement; limbs robust; claws, compressed sharp, slightly hooked; third toe a little the longest; palms and under surface of the toes naked; soles of hind feet clothed with hairs, except on the tubercles at the root of the toes."

The colour is deep reddish brown on the whole of the upper surface lips, chin, throat, inside of legs and belly white. There is sometimes a black line running from near the shoulders along the sides to near the thighs.

It is in some parts of the country called the Chickaree, and its habits are thus sketched by the learned authors of the quadrupeds of America.

"The Hudson's Bay squirrel is fearless, and heedless, to a great degree, of the presence of man; we have had one occasionally pass through our yard, sometimes ascending an oak or a chesnut, and proceeding leisurely through our small woody lawn. These little animals are generally found singly, although it is not uncommon for many to occupy the same piece of wood-land, if of any extent. In their quick, graceful motions from branch to branch, they almost remind one of a bird, and they are always neat and cleanly in their coats, industrious, and well provided for the cold of winter.

"In parts of the country, the Chickaree is fond of approaching the farmers store houses of grain, or other products of the fields, and occasionally it ventures even so far as to make a nest for itself in some of his out-buildings, and is not dislodged from such snug quarters without undergoing a good deal of persecution.

"One of these squirrels made its nest between the beams and the rafters of a house of the kind we have just spoken of, and finding the skin of a peacock in the loft, appropriated the feathers to compose its nest, and although it was destroyed several times, to test the perseverance of the animal, it persisted in re-constructing it. The Chickaree obtained this name from its noisy chattering note, and like most other squirrels, is fond of repeating its cries at frequent intervals. Many of the inhabitants of our Eastern States refuse to eat squirrels of any kind, from some prejudice or other; but we can assure our readers that the flesh of this species, and many others, is both tender and well-flavoured, and when nicely broiled, does not require a hunter's appetite to recommend it.

"The habits of this little squirrel are, in several particulars, peculiar; whilst the larger gray squirrels derive their sustenance from buds and nuts, chiefly inhabit warm or temperate climates, and are constitutionally fitted to subsist during winter on a small quantity of food, the Chickaree exhibit the greatest sprightliness and activity amidst the snows and frosts of our Northern regions

and consequently is obliged, during the winter season, to consume as great a quantity of food as at any other. Nature has, therefore, instructed it to make provision in the season of abundance for the long winter that is approaching; and the quantity of nuts and seeds it often lays up in its store-house, is almost incredible. On one occasion we were present, when a bushel and a half of shell-barks (*Carya alba*,) and chesnuts, were taken from a hollow tree occupied by a single pair of these industrious creatures; although generally the quantity of provision laid up by them is considerably less. The Chickaree has too much foresight to trust to a single hoard, and it often has several, in different localities among the neighbouring trees, or in burrows dug deep in the earth. Occasionally these stores are found under leaves, beneath logs, or in brush-heaps, at other times they are deposited in holes in the ground; and they are sometimes only temporarily laid by in some convenient situation, to be removed at leisure. When, for instance, nuts are abundant in the autumn, large quantities in the green state, covered by their thick envelope, are collected in a heap near the tree whence they have fallen; they are then covered up with leaves, until the pericarp, or thick outer covering, either falls off or opens, when the Squirrel is able to carry off the nuts more conveniently. In obtaining shell-barks, butter-nuts, (*Juglans cinerea*) chesnuts, hazelnuts, &c., this squirrel adopts the mode of most of the other species. It advances as near to the extremity of the branch as it can with safety, and gnaws off that portion on which the nuts are dependent. This is usually done early in the morning, and the noise occasioned by the falling of large bunches of chesnut burrs, or clusters of butter-nuts, hickory, or beech-nuts, thus detached from the parent stem, may be heard more than a hundred yards off. Some of the stems attached to the nuts are ten inches or a foot in length. After having thrown down a considerable quantity, the squirrel descends and drags them into a heap, as stated above.

"Sometimes the hogs find out these stores, and make sad havoc in the temporary depot. But Providence has placed much food of a different kind within reach of the red-squirrel during winter. The cones of many of our pines and firs in high northern latitudes are persistent during winter; and the Chickaree can be supported by the seeds they contain, even should his hoards of nuts fail. This little squirrel seems also to accommodate itself to its situation in another respect. In Pennsylvania, and the southern part

of New York, where the winters are comparatively mild, it is very commonly satisfied with a hollow tree as a winter residence; but in the latitude of Saratoga, N. Y., in the northern part of Massachusetts, in New Hampshire, Maine, Canada, and farther north, it usually seeks for additional protection from the cold, by forming deep burrows in the earth. Nothing is more common than to meet with five or six squirrel holes in the ground, near the roots of some white pine or hemlock; and these retreats can be easily found by the vast heaps of scales from the cones of pines and firs, which are in process of time accumulated around them. This species can both swim and dive. We once observed some lads shaking a red-squirrel from a sapling that grew on the edge of a mill-pond. It fell into the water, and swam to the opposite shore, performing the operation of swimming moderately well, and reminding us by its movements of the meadow-mouse, when similarly occupied. It was "headed" by its untiring persecutors, on the opposite shore, where on being pelted with sticks, we noticed it diving two or three times, not in the graceful curving manner of the mink, or musk-rat, but with short and ineffectual plunges of a foot or two at a time.

"We have kept the Chickaree in cages, but found it less gentle, and more difficult to be tamed than many other species of the genus.

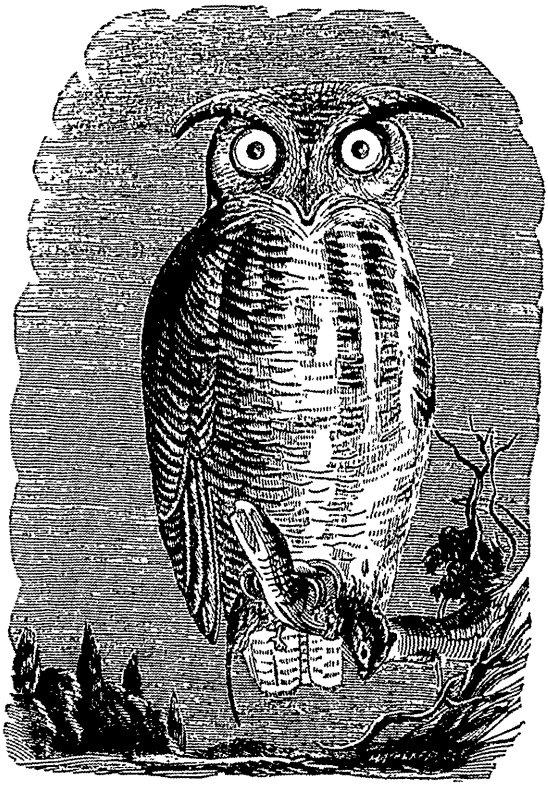
"RICHARDSON informs us that in the fur countries, "the Indian boys kill many with the bow and arrow, and also take them occasionally with snares set round the trunks of the trees which they frequent." We have observed that during winter a steel-trap baited with an ear of corn, (maize,) placed near their burrows at at the foot of large pine or spruce trees, will secure them with the greatest ease.

"The limits of the northern range of this species are not precisely determined, but all travellers who have braved the snows of our Polar regions, speak of its existence as far north as their journeys extended. It has been observed in the 68th or 69th parallel of latitude; it also exists in Labrador, Newfoundland and Canada. It is the most common species in New England and New York, and it is by no means rare in Pennsylvania and New Jersey, especially in the hilly or mountainous portions of the latter state. It is seen, in diminished numbers, in the mountains of Virginia, although in the alluvial parts of that State, it is scarcely known; as we proceed southwardly, it becomes more rare, but still continues

to be met with on the highest mountains. The most southern locality to which we have traced it, is a high peak called the Black mountain, in Buncombe county, N. Carolina. The woods growing in that elevated situation are in some places wholly composed of balsam-fir trees, (*Abies balsamea*,) on the cones of which these squirrels feed. There this little animal is quite common, and has received a new English name, viz., that of "Mountain boomer." Toward the west we have traced it to the mountains of Tennessee; beyond the Rocky mountains, it does not exist. In the Russian settlements on the Western coast, it is replaced by the Downy Squirrel, (*Sc. lanuginosus.*) In the vicinity of Columbia, and for several hundred miles along the mountains South of that river, by RICHARDSON'S Columbian squirrel; and in the mountainous regions bordering on California, by another small species much resembling it, which we hope, hereafter, to present to our readers.

"Although this species from its numbers and familiarity, as well as from its general diffusion, has been longer known than any other of our squirrels, and has been very frequently described, it has, with few exceptions, retained its name of *Hudsonius*. ERXLEBEN supposed it to be only a variety of the common squirrel, *S. vulgaris*, of Europe, and so describes it. The *Sciurus Hudsonius* of GMELIN is a flying squirrel, (*Pteromys sabrinus*,) and the Carolina gray squirrel, which in Shaw's General Zoology, vol. ii., p. 141, is given as a variety of *Sciurus Hudsonius*, is our own species, (*Sc. Carolinensis*). This species was unknown to LINNÆUS. PALLAS appears to have been the first author, who gave the specific name of *Hudsonius*, (see Pall. Glir. p. 377, A. D. 1786, and GMELIN, in 1788, adopted his name.)

"In examining the form, and inquiring into the habits of this species; we cannot but observe a slight approach to TAMIAS, and a more distant one to SPERMOPHILUS. Its ears are placed farther back than in the squirrels generally, its tail is only sub-distichous, and withal it often digs its own burrow, and lives indiscriminately in the ground and on trees. In all these particulars it appears, in connexion with the Downy squirrel, (*Sc. lanuginosus*,) to form a connecting link between SCIURUS and TAMIAS. It has, however, no cheek pouches, and does not carry its food in its cheeks in the manner of the TAMIÆ and SPERMOPHILI, but between its front teeth, like the rest of the squirrels."



ARTICLE LVIII.—*On the great Horned Owl, Bubo Virginianus.*

GENUS BUBO.—Cuvier.

Generic Characters.

Bill short, stout, broader than high at the base, compressed toward the upper end; upper mandible with its dorsal line curved from the base, the edges with a slight festoon, the tip trigonal, very acute; lower mandible with the dorsal line convex, the tip obliquely truncate; nostrils broadly elliptical, aperture of ear elliptical, less than half the height of the head, without operculum; feet of ordinary length; tarsi and toes feathered; Plumage full and very soft; facial disks complete; a tuft of elongated feathers on each side of the crown of the head; wings ample, the first quill short, the fourth longest; tail of ordinary length, rounded.

The Great Horned Owl.

Bubo Virginianus.

This beautiful and majestic bird was called by Buffon, Duc de Virginie; by the Cree Indians, Netowky—Omeesew, and according to Sir John Richardson, by the Indians of the plains of the Sascatchewan, Otowack Oho. The savages it is said hold it in great respect, as a bird of evil omen, and carry this superstition so far as to be displeased with any one who imitates the unearthly hootings of this midnight marauder.

Wilson, who never looses an opportunity of pleading affectionnately for his Owls and Woodpeckers, remarks that there is something in the character of the Owl so recluse, solitary and mysterious, something so discordant in the tones of its voice, heard only amid the silence and gloom of night, and in the most lonely and sequestered situations, as to have strongly impressed the minds of mankind in general with sensations of awe and abhorrence of the whole tribe. The poets have indulged freely in this general prejudice; and in their descriptions and delineations of midnight storms and gloomy scenes of nature, the Owl is generally introduced to heighten the picture. Ignorance and superstition in all ages and in all countries listen to the voice of the Owl, and even contemplate its physionomy with feelings of disgust and a kind of fearful awe. The priests or conjurors among some of our Indian nations, have taken advantage of the reverential honor for this bird, and have adopted the great Horned Owl, the subject of the present account, as the symbol or emblem of their office.

"Among the Creeks, the junior priests or students constantly wear a white mantle, and have a great Horned Owl skin, cased and stuffed very ingeniously, so well executed as almost to appear like the living bird, having large sparkling glass beads, or buttons fixed in the head for eyes. This insignia of wisdom and divination they wear sometimes as a crest on the top of the head; at other times, the image sits on the arm or is borne in the hand. These bachelors are also distinguished from other people by their taciturnity, grave and solemn countenance, dignified step, and singing to themselves songs or hymns in a low sweet voice, as they strole about the town.

Nothing is a more effectual cure for superstition than a knowledge of the general laws and productions of nature, no more forcibly leads our reflections to the first great self existent CAUSE

of all, to whom our reverential love is then humbly devoted, and not to any of his dependent creatures, with all the gloomy habits and ungracious tones of the Owl, there is nothing in this bird supernatural or mysterious, or more than that of a simple bird of prey, formed for feeding by night, like many other animals, and of reposing by day. The harshness of its voice occasioned by the width and capacity of its throat, may be intended by heaven as an alarm and warning to the birds and animals on which it preys, to secure themselves from danger. The voices of all carnivorous birds and animals are also observed to be harsh and hideous, probably for this very purpose."

A good specimen of the great Horned Owl, taken in winter when his plumage is in its most full state of thickness and softness, is one of the most handsome of American birds. The length is nearly two feet; the long plume-like tufts, or horns as they are called, several inches in length, and the whole body richly barred and variegated with white, brown and tawney colours. The eyes are large yellow, flashing with a golden light when excited, and the whole bearing fearless and noble.

This species lives retired in the most secluded recesses of the forest, but often sallies forth at night on a tour of inspection, around the barn where now and then some unlucky fowl becomes his prey. His strength is sufficiently great to enable him to capture and destroy birds several times his own bulk, and consequently the common barn fowls are easily carried away to his haunt in the woods. Wild turkeys, mallards, guinea fowls, young rabbits, hares, squirrels, mice, partridges, and small birds of all kinds, furnish him with subsistence, and as he hunts while others sleep, no doubt his larder is generally well supplied.

The great Horned Owl begins to pair early in spring, the nest is very long, and built upon a large branch usually, at no great distance from the trunk of the tree. It is composed externally of crooked sticks, and is lined with coarse grasses and some feathers. The whole measures nearly three feet in diameter; the eggs, which are from three to six, are almost globular in form, and a dull white colour. The male assists the female in sitting on the eggs. Only one brood is raised in a season. The young remain in the nest until fully fledged, and afterwards follow the parents for a considerable time, uttering a mournful sound to induce them to supply them with food. They acquire the full plumage of the old birds in the first spring, and until then, are con-

siderably lighter, with more dull buff in their tints. The nest is sometimes made in the hollows of large partially decayed trees, and occasionally in the fissures of rocks. In these cases very little preparation is made previously to the laying of the eggs.

"The flight is elevated, rapid and graceful. It sails with apparent ease; and in large circles, in the manner of an eagle, rises and descends without the least difficulty, by merely inclining its wings or its tail as it passes through the air. Now and then it glides silently close over the earth, with incomparable velocity, and drops, as if shot dead, on the prey beneath. At other times, it suddenly alights on the top of a fence stake, or a dead stump, shakes its feathers, arranges them, and utters a shriek so horrid that the woods around echo to its dismal sound. Now it seems as if you heard the barking of a cur dog; again, the notes are so rough and mingled together, that they might be mistaken for the last gurglings of a murdered person, striving in vain to call for assistance, at another time, when not more than fifty yards distant, it utters its more usual *hoo*, *hoo*, *hoo-e*, in so peculiar an under tone, that a person unacquainted with the notes of this species might easily conceive them to be produced by an owl more than a mile distant. During the utterance of all these unmusical cries, it moves its body and more particularly its head, in various ways, putting them into positions, all of which appear to please it much, however grotesque they may seem to the eye of man. In the interval following each cry, it snaps its bill, as if by way of amusement; or, like the wild boar sharpening the edges of his tusks, it perhaps expects that the action will whet its mandibles.

It roosts by day in thick branching trees, its body being erect, its plumage closed, its tufted head feathers partially lowered, and its head half-turned and resting on one shoulder.

When the sun shines brightly, this bird is easily approached; but if the weather be cloudy, it rises on its feet at the least noise, erects the tufts of its head, gives a knowing kind of nod, flies off in an instant, and generally proceeds to such a distance, that it is difficult to find it again. When wounded, it exhibits a revengeful tenacity of spirit, scarcely surpassed by any of the noblest of the Eagle tribe, disdaining to scramble away like the barred Owl, but facing its enemy with undaunted courage, protruding its powerful talons, and snapping its bill, as long as he continues in his presence. On these occasions, its large goggle eyes are seen to

open and close in quick succession, and the feathers of its body, being raised, swell out its apparent bulk to nearly double the natural size." This bird is found all over the United States and the British Provinces, from Texas to the Artic regions. They are frequently caught in traps set for other animals in Canada, or otherwise killed, and when a bird strictly nocturnal in its habits is thus often met with it may be considered abundant.

DESCRIPTION.

Upper part of the head brownish black, mottled with light brown, the tufts of the same colours, margined with brown; face brownish red, with a circle of blackish brown; upper parts undulatingly banded and minutely mottled with brownish black and yellowish red, behind tinged with grey; wings and tail light brownish yellow, barred and mottled with blackish brown and light brownish red; chin white; upper part of throat light reddish, spotted with black, a band of white across the middle of the fore neck; its lower part and the breast light yellowish red, barred with deep brown, as are the lower parts generally; several longitudinal brownish black patches on the lower fore neck; tarsal feathers light yellowish red, obscurely barred.

Male 23, 56. Female, 25, 60.

Synonims, great Horned Owl, Striæ Virginiana, of Wilson in American ornithology, and by other authors.

ARTICLE LIX. *The Snowy Day Owl. Surnia Nyctea.*

Genus Surnia.—(Dumeril.)

Generic Characters.—Bill very short, strong, its upper outline decurved from the base; lower mandible abruptly rounded, with a sinus on each side. Nostrils elliptical, rather large. Aperture of ear elliptical, simple, not more than half the height of the head. Feet strong; tarsi very short or of moderate length. Plumage rather dense; facial disks, incomplete above. Wings very large, the third quill longest, the first with the filaments thickened, and a little free, but scarcely recurved at the end. Tail varying in length. (Audubon Syn, page 21.)

Audubon in his synopsis recognises in the family Strigidæ, (the owls) siæ genera, Surnia the day owl; Ulula, the Night owl; Striæ, the Screech owl; Syrnium, the Hooting owl; Otus, the

Eared owl; and Bubo, the Horned owl. There are four species of the first genus, and they, unlike others of the family, hunt by day as well as by night. The largest species and the one most common in Canada is the following:

The Snowy Day Owl.

Surnia Nyctea.—(Linn).

In this magnificent species, the head is small in proportion to the size of the body; the bill almost entirely hidden by the hairy feathers at its base; plumage snow white, but mor or less variegated with transverse brown spots or stripes; the younger the bird is the longer and more numerous are those spots and stripes; very old individuals are pure white, without any brown spot; the feet are covered with fine hair-like feathers so that each seems buried in a lock of coarse wool, the claws only peeping through. The length of the male is about 21 inches, spread of wings 53; female 26 65.

This is a northern species, the geographical range being extended quite into the arctic circle, and according to many good ornithologists, it is identical with the bird bearing the same name which is found in all the polar regions of the old world. It is called by the Crees, Wapow-keetho or Wapohoo, and by the Esquimaux, Oopeeguak. It hunts during the day as well as in the dusky light of the morning and evening, feeding upon hares, squirrels, mice, fishes and birds. Audubon found in the stomach of one specimen, the whole of a large rat in pieces of considerable size, the head and tail being almost entire, the same Naturalist saw some of these birds catching fish; they invariably laid down flat upon the rock with the body placed lengthwise along the border of the hole, the head also laid down but turned towards the water, one might have supposed the bird sound asleep, as it would remain in the same position until a good opportunity of securing a fish occurred, which was never missed; for as the latter unwittingly rose to the surface, near the edge, the owl thrust out the foot next the water, and with the quickness of lightning, seized it and drew it out. The owl then removed to the distance of a few yards, devoured his prey, and returned to the same hole; or, if it had not perceived any more fish, flew only a few yards over the many holes, marked one, and alighted at a little distance from it. It then squatted, moved slowly towards the edge, and

lay as before, watching for an opportunity, whenever a fish of any size was hooked, the owl struck the other foot also into it, and flew off with it to a considerable distance. In tried instances of this kind, the bird carried its prey across the river into the woods as if to be quite out of harm's way, there was no note uttered on these occasions; even when two birds joined they ate in silence.

The hunters sometimes find that the musk rats caught in their traps have been devoured. One of them placed some traps with musk rats for bait, and was rewarded with the sight of one or more Snowy Owls each morning, until the thieves as he called them, were pretty well exterminated.

The flight of this bird is firm and long sustained, although smooth and perfectly noiseless. It passes swiftly over its hunting ground, seizes its prey by instantaneously falling upon it, and generally devours it upon the spot. When the objects of its pursuit are on the wing, such as ducks, geese, or pigeons, it gains upon them by urging its speed, and strikes them somewhat in the manner of the Peregrine Falcon. It is fond of the neighbourhood of rivers and small streams, having in their course cataracts or shallow rapids, on the borders of which it seizes on fishes in the manner above mentioned.

This species is somewhat common in Canada, and specimens of it may be seen in almost every collection of stuffed birds. It occurs in Nova Scotia, New Brunswick, and all the Northern States, but does not descend, except occasionally, to the southern part of the Union. In Lapland it is said, they are shot with a ball while hunting after moles and lemmings. Sometimes when the sportsman has shot a grouse, the Snow Owl sails quietly down and bears it away before the lawful owner can secure his prize. Sir John Richardson says it frequents most of the Arctic lands that have been visited, but retires with the Ptarmigan, on which it preys, to more sheltered districts in winter. When I have seen it, says this author, on the barren grounds, it was generally squatting on the earth; and if put up, it alighted again after a short flight, but was always so wary as to be approached with difficulty. In woody districts it shews less caution. I have seen it pursue the American hare on the wing, making repeated strokes at the animal with its feet. In winter, when this Owl is fat, the Indians and white residents in the Fur countries esteem it to be good eating. Its flesh is delicately white." Wilson says from

all the specimens he has examined, he is of opinion that the male only becomes pure white with age, the female never.

Its habits during the breeding season, such as the construction of its nest, period of incubation, &c., do not appear to be well known.

ARTICLE. LX.—*The Enemies of the Wheat Fly.*

The life of an insect consists of several stages. The parent fly lays an egg, and from that egg is hatched a worm, which after a period of existence more or less extended, according to the species, makes a sort of retrograde step, if we may so speak, in the journey of vitality and becomes a thing, which often more resembles an egg than the perfect insect intended to be finally produced. In this, *the pupa* state, the little animal is neatly enveloped in a membraneous shell, and remains for a time without sustenance or motion, but all the time undergoing a natural process, whereby in the end the gaudy butterfly, the hard-winged beetle, or the terrible wheat fly, is slowly but surely elaborated: and each of these again, after enjoying the sweets of insect life for a while, lays its egg and dies; thus completing the circle.

There is more than this, however, to excite our admiration. As in most instances the parent dies before its young is hatched, and as with many species the larva, immediately upon its exit from the egg, requires a particular kind of food, without a supply of which it must inevitably perish; there can be little doubt but that if this be not previously provided, the series of events would be abruptly broken off by the death from starvation of the new born insect.

In these cases where the mother can never see her progeny, how is she to know what kind of food it will require? We do not yet know enough of nature to answer that question. Of this much only we are quite certain. The parent always seeks out a mass of provision of the proper sustenance, and lays her egg either in or near it, so that when the latter is hatched, the little helpless worm that comes forth, has only to open its mouth and eat. Thus the Hessian Fly deposits her egg on the blade of the wheat plant, perhaps the only plant whose juices will nourish her young, making this selection she is guided by some pre-real, the nature of which is as yet unknown to the most profound metaphysicians. And when the larva comes forth, guided by another instinct, it immediately scrambles away straight down the

stalk until it arrives at the joint, where it becomes fixed, and is nourished by the vegetable fluids that otherwise would have invigorated the plant. The *wheat midge*, a second species, selects the flower as it is only on the grain that her future progeny can subsist. And she so manages with respect to the time, that just at the moment when her young ones are sufficiently advanced to require food, the grain of wheat is sufficiently grown to feed them.

With these two species, the larvæ subsist upon vegetable food, but there are others whose organization is such, that they can only live upon animal substances. Consequently such are sought out by the parent; one kind selecting a dead and another a living animal in which to deposit the egg. Others construct a nest, lay the egg, then sally forth, kill some other insect and place the carcass in the nest, where it will be ready for the larva to feed upon as soon as the shell is broken.

It is said by ornothologists, that certain birds too indolent to construct nests of their own, leave their eggs in those of other species, where they are hatched by the unwittingly bestowed warmth of the strangers. Insects are still more unprincipled. The *Ichneumon* actually waits until the wheat midge has laid her egg and until the larva is hatched, when she seizes upon the youthful destroyer of the staff of life, bores a hole through his skin and deposits her egg in the soft parts of his body. The young wheat midge is thus compelled much against his will it appears to become a sort of external step mother to the young *Ichneumon*, who is hatched inside, and immediately devours his foster parent.

In was for this reason that the *Ichneumon* was supposed, at one time, to be the insect that injured the wheat, because they were seen to come out of the empty pupa cases of the wheat fly, when in fact, instead of being injurious it is the most important protector, as its own existence depends upon the destruction of the species which really effects the damage.

We do not know that the two species of insects described in what follows occur in this country, but as everything bearing upon the principle subject, that of the natural history of insects injurious to our crops is of importance, we think it will be useful to publish the account of them given in the JOURNAL OF THE ROYAL AGRICULTURAL SOCIETY *of England*, *Vol.* 6, BY JOHN CURTIS, F. L. S.

Referring to the *Ichneumon* this author says:

"This insect is found upon grasses as early as June, and on the

glumes of the wheat in July and August, when it runs over the ears and searches out the infected ones, depositing a single egg in each of the larvæ by means of its sharp tail. The late Mr. A. Mathews, before he left England, sent me specimens, informing me that he had found them in the greatest abundance in the glumes of the wheat in a field near Sittingbourne, Kent, the beginning of July. Never having seen this *Ichneumon* depositing its eggs, I cannot satisfy the curiosity of the reader better than by transcribing Mr. Kirby's graphic account of its operations. "To see our little *Ichneumon*," says Mr. Kirby, "deposit its egg in the caterpillar of the wheat-fly is a very entertaining sight. In order to enjoy this pleasure I placed a number of the latter upon a sheet of white paper, at no great distance from each other, and then set an *Ichneumon* down in the midst of them. She began immediately to march about, vibrating her antennæ very briskly; a larva was soon discovered, upon which she fixed herself, the vibratory motion of her antennæ increasing to an intense degree: then bending her body obliquely under her breast, she applied her anus to the larva, and during the insertion of her *aculeus* and the depositing of the egg her antennæ became perfectly still and motionless. Whilst this operation was performing, the larva appeared to feel a momentary sensation of pain, for it gave a violent wriggle. When all was finished, the little *Ichneumon* marched off to seek for a second, which was obliged to undergo the same operation, and so on to as many as it could find in which no egg had been before deposited, for it commits only a single egg to each larva. I have seen it frequently mount one which had been pricked before, but it soon discovered its mistake and left it. The size of it is so near that of the *Tipula*, that I imagine the larva of the latter could not support more than one of the former, and, therefore, instinct directs it to deposit only a single egg in each; besides, by this means one *Ichneumon* will destroy an infinite number of larvæ."

"These parasites are all included in the Order HYMENOPTERA, and the Family ICHNEUMONIDES ADSCITI; the species I am about to describe is comprised in the Genus PLATYGASTER;* it has been

* So named from some of the larger ones having broad bodies.

named by Mr. Kirby *Ichneumon Tipulæ*, and is now described as the—

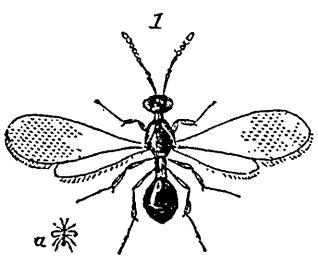


Fig. 1. *Platygaster Tipulæ.*

1. P. Tipulæ. fig. 1; *a*, the natural size. — *Female* pitch-coloured, shining: antennæ nearly as long as the body, inserted at the lower part of the face, slender, clavate, geniculated or angulated; as if broken, slightly pubescent; ochreous, and ten-jointed, the four terminal joints brown and obovate, the apical one conical; basal joint long, curved, and clavate; second and third subovate, the latter very slender; fourth a little longer; fifth and sixth minute (fig. *b*); head black, subglobose, thickly and finely punctured, with a minute tooth between the base of the antennæ; eyes oval and lateral, ocelli large and placed nearly in a straight line across the crown; thorax somewhat globose with minute pale pubescence; scutellum horizontal, long, conical, and mucronated; the spine ferruginous; abdomen small, scarcely larger than the thorax; slightly depressed, obovate, black and very shining, attached by a short stout pedicel which is ferruginous at the base; the second segment forms a convex shield, which nearly covers the back, with three or four rings towards the apex; the flexible tip is armed with a very long curved ovipositor, like a hair, which is concealed in the abdomen when at rest: the four wings transparent, iridescent, pubescent, and ciliated, destitute of nervures, the superior much the largest, the apex quite round: leg strong, bright ochreous; thighs thickened at their extremities; tibiæ spurred at the apex, very clavate, hinder with the knob sometimes fuscous; tarsi slender and five-jointed. "*Male* black, shining, very smooth, sparingly clothed with short pubescence: head excessively finely punctured, slightly shining: eyes and ocelli pitchy black: antennæ pitchy, first to fifth joints reddish: apex of scutellum fuscous; metathorax and first abdominal segment rough, obscure, pilose: abdomen smooth, shining; second segment with two little pits at the base; legs pale reddish; hinder tibiæ and apex of tarsi pitchy: wings somewhat transparent: scales pitchy."

"It seems that the males do not differ, except in a trifling degree, in the structure of the horns, in which, I believe, the fourth joint is

larger and the tenth longer and more pointed: but it is very remarkable that whilst the females occasionally swarm, so little is known of the habits of the opposite sex that I have not yet been able to meet with a specimen. The only one I ever saw was captured by Mr. Haliday on a rose-tree, and the above characters are translated from Mr. F. Walker's paper upon the Genus *Platygaster*.* This is such an extensive group that he has described 99 species which inhabit this country, and amongst them is one named *P. Tritici* by Mr. Haliday, who found it on corn and willows in England and Ireland, and from its specific name it is evident that talented naturalist considered it to be connected with our wheatfields.†

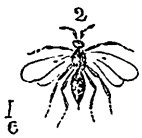
"The second species described by Mr. Kirby he has named ICHNEUMON INSERENS; it is apparently a PLATYGASTER; ‡but as I have not been able to find the specimen in his collection, I must be satisfied in transcribing his account and copying his figures. He says, "Upon the 7th of June I observed a very minute *Ichneumon* exceedingly busy upon the ears of wheat, which, at first, I took for *Ichneumon Tipulæ;* but upon a closer examination I found it to be a species entirely distinct, as will appear when I come to describe it. As soon as I was convinced of this, and observed that it pierced the florets at a time when no larvæ had made their appearance, I conjectured that it must lay its eggs in the eggs of the *Tipula*." "This insect is furnished with an *aculeus* three or four times its own length (fig. *c*), which is finer than a hair and nearly as flexile; this is commonly concealed within the abdomen, but when the animal is engaged in laying its eggs it is exserted; one day it gave me a full opportunity of examining this process. It inserts its aculeus between the valvules of the corolla near the top of the floret; its antennæ are then nearly doubled and motionless, its thorax is elevated, and its head and abdomen depressed; the latter, when it withdraws the *aculeus*, is moved frequently from side to side before it can extricate it. This insect has allowed me to examine its operations under a lens for six or seven minutes: upon opening the floret into which it had

* Entomological Mag., vol. iii, p. 220.

† Curtis's Brit. Ent., fol. 309; and Guide, Genus 585, where 108 species are recorded.

‡ I have included it in the Genus *Inostemma* in the 'Guide', a Genus which has been formed out of *Platygaster;* but whether I have been right in its location, I am unable at present to determine for want of materials.

introduced its aculeus, I could find neither egg nor larva of the *Tipula*; but, upon examining it very closely under three glasses, I discovered, scattered over one of the valvules of the corolla, a number of globular eggs extremely minute, evidently not those of that insect. It is possible that there were in this floret eggs of the latter, which might be destroyed upon opening it, or escape my observation. At other times I have found eggs of the *Tipula Tritici*, and once some larvæ, in florets upon which I had observed this *Ichneumon* busy." "From the time in which it first makes its appearance, ten days before the hatching of the first larvæ, I I am inclined to adopt my original conjecture, that the eggs are its prey; and yet there seems not to be a sufficient disproportion between the size of the one and the other for this purpose; at least, it must take more than one to nourish a larva of the *Ichneumon* to its proper size.*



2. *Platygaster inserens.*

"2. Platygaster? inserens. *Kirby.* Very black; antennæ clubbed; abdomen lance-shaped, shining:"† fig. 2; *e*, the natural size.—*Female*, body very black; antennæ bent, as if broken, and clubbed; basal joint long, stout, rigid, and clavate, reverse heart-shaped, cleft at the apex viewed laterally; second joint stout, oval, 4 following globular and extremely minute, the remainder forming a compact ovate conic club of 4 joints (fig. *d*): head and thorax somewhat dull in surface: abdomen sessile, lanceolate, excessively black and glossy, very acute, furnished with a very long flexile slender ovipositor, which is exserted (fig. *c*); wings transparent, nerveless, longer than the body; superior with a black line leading from the base towards the middle terminated by a black dot: legs blackish; thighs deep black, somewhat clavate; length less than a line.

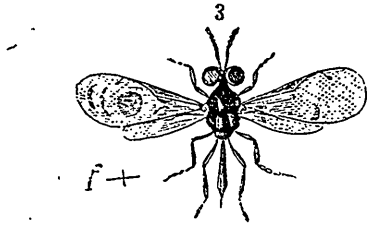
"The third parasite detected by Mr. Kirby appeared on the same day that the *Platygaster Tipulæ* came forth in great numbers. He states that, "on the 22nd of June, I observed another *Ichneumon* not uncommon, piercing the florets of the wheat (fig. 3 and 4). This species did not appear to insert its *aculeus* between the valvules of the corolla, but to pierce the glumes of the calyx, to effect which purpose it is armed with a very short one subexserted: of this I found both the sexes; the male was distinguished

* Trans. Linn. Soc., vol. v. p. 102.

† Trans. Linn. Soc., vol. v. p. 107.

from the female by its large eyes, placed very near each other, with reticulations unusually visible. I presume this to lay its eggs in the larvæ, but have not been able positively to ascertain the fact.*

"This singular species has been characterised as the Genus MACROGLENES by Mr. Westwood, and I am happy in being able to give drawings from nature of the sexes, as the figure in the Linnæan Transactions is not sufficiently correct to identify it.† Mr. Westwood, however, has examined Mr. Kirby's original specimen of *Ichneumon penetrans*, and informs me that it is identical with his Genus *Macroglenes*, which is comprised in the Family CHALCIDIDAE, a parasitic group of immense extent as to amount of species, and scarcely yielding in numbers to any of the insect tribes as to aggregate masses. I have already described and figured several species of *Chalcididæ;* they frequently inhabit and feed upon the parasitic larvæ of *Hymenoptera*, to keep them within due bounds.



Male. *Female.*

"3. Macroglenes penetrans.—The *male* is dark blue-green, sometimes slightly tinged with violet, shining; antennæ not so long as the head and thorax, geniculated and clavate, ten-jointed, basal joint long; second as stout, oval; three following very minute and saucer-shaped; sixth and seventh stout, cup-shaped; the remainder forming a compact black ovate-conic club: head large and transverse, face orbicular, including the eyes, which are very large, lateral, reddish brown, orbicular, coarsely reticulated and approaching each other on the crown, ocelli 3, forming a long triangle, prominent and larger than usual, especially the apical one: thorax oval, as broad as the head; the sutures deep, forming

* Trans. Linn. Soc., p. 104.

† Mr. Haliday presented me with a male; for the loan of the other sex I am indebted to Mr. F. Walker.

4 very convex protuberances; abdomen very much compressed, not longer than the thorax, and somewhat elliptical viewed laterally, with six distinct segments, and a short exserted slender process at the apex: wings ample, very transparent, iridescent; superior with a subcostal nervature reaching nearly to the middle, where it unites with the costa, and a little beyond it forms a short branch, terminated by a minute dot; legs simple and slender; tarsi five-jointed, dirty white, darker at the tips (fig. 3; *f*, the natural size); length three-fourths of a line, expanse one and two-thirds of a line. The *female* is scarcely so large, and differs, I think, in having shorter antennæ, with a more abrupt club; the face is very concave, forming a broad deep groove: the 3 ocelli are placed in a transverse line at the back of the crown: the eyes are not large, but brown, oval, and remote: the abdomen is very much compressed, the back forming a sharp edge, and it is very deep viewed laterally, the apex is truncated, and an oviduct enclosed between two valves projects beyond it; fig. 4; *g*, the natural size."*

ARTICLE XLI.—*Natural History, from "Glaucus, or the Wonders of the Shore."* †

I have said, that there were excuses for the old contempt of the study of Natural History. I have said, too, it may be hoped, enough to show that contempt to be now ill-founded. But still there are those who regard it as a mere amusement, and that as a somewhat effeminate one; and think that it can at best help to while away a leisure hour harmlessly, and perhaps usefully, as a substitute for coarser sports, or for the reading of novels. Those, however, who have followed it out, especially on the sea-shore, know better. They can tell from experience that over and above its accessory charms of pure sea-breezes, and wild rambles by cliff and loch, the study itself has had a weighty moral effect upon their hearts and spirits. There are those who can well understand how the good and wise John Ellis, amid all his philanthropic labors for the good of the West Indies, while he was spending his

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* Mr. Haliday has described two more species of this genus in vol. iii. of the Trans. of the Ent. Soc., p. 295; he found all of them in various wild flowers.

† Glaucus, or the Wonders of the Shore, by Charles Kingsley, author of "Amyas Leigh," "Hypatia," *&c.* American edition; Boston, *Ticknor and Fields*, 1855.

intellect and fortune in introducing into our tropic settlements the bread-fruit, the mangosteen, and every plant and seed which he hoped might be useful for medicine, agriculture, and commerce, could yet feel himself justified in devoting large portions of his ever well-spent time to the fighting the battle of the corallines against Parsons and the rest, and even in measuring pens with Linné, the prince of naturalists. There are those who can sympathize with the gallant old Scotch officer mentioned by some writer on sea-weeds, who, desperately wounded in the breach at Badajos, and a sharer in all the toils and triumphs of the Peninsular war, could in his old age show a rare sea-weed with as much triumph as his well-earned medals, and talk over a tiny spore-capsule with as much zest as the records of sieges and battles. Why not? That temper which made him a good soldier may very well have made him a good naturalist also. And certainly, the best naturalist, as far as logical acumen, as well as earnest research, is concerned, whom England has ever seen, was the Devonshire squire, Colonel George Montagu, of whom Mr. E. Forbes * well says, that "had he been educated a physiologist," (and not, as he was, a soldier and a sportsman,) "and made the study of nature his aim and not his amusement, his would have been one of the greatest names in the whole range of British science." I question, nevertheless, whether he would not have lost more than he would have gained by a different training. It might have made him a more learned systematizer; but would it have quickened in him that "seeing eye" of the true soldier and sportsman, which makes Montagu's descriptions indelible word-pictures, instinct with life and truth? "There is no question," says Mr. E. Forbes, after bewailing the vagueness of most naturalists, "about the identity of any animal Montagu described. . . . . He was a forward-looking philosopher; he spoke of every creature as if one exceeding like it; yet different from it, would be washed up by the waves next tide. Consequently his descriptions are permanent." Scientific men will recognize in this the highest praise which can be bestowed, because it attributes to him that highest faculty,—*The Art of Seeing:* but the study and the book would not have given that. It is God's gift, wheresoever educated; but its true school-room is

* "British Star-fishes." This delightful writer, and eager investigator, has just died, in the prime of life, from disease contracted (it is said) during a scientific journey in Asia Minor: one more martyr to the knight-errantry of science.

the camp and the ocean, the prairie and the forest; active self-helping life, which can grapple with Nature herself, not merely with printed books about her. Let no one think that this same Natural History is a pursuit fitted only for effeminate or pedantic men. We should say rather that the qualifications required for a perfect naturalist are as many and as lofty as were required by old chivalrous writers, for the perfect knight-errant of the Middle Ages; for (to sketch an ideal, of which we are happy to say our race now affords many a fair realization) our perfect naturalist should be strong in body; able to haul a dredge, climb a rock, turn a boulder, walk all day, uncertain where he shall eat or rest; ready to face sun and rain, wind and frost, and to eat or drink thankfully anything, however coarse or meagre; he should know how to swim for his life, to pull an oar, sail a boat, and ride the first horse which comes to hand; and, finally, he should be a thoroughly good shot, and a skilful fisherman; and, if he go far abroad, be able on occasion to fight for his life.

For his moral character, he must, like a knight of old, be first of all gentle and courteous, ready and able to ingratiate himself with the poor, the ignorant, and the savage; not only because foreign travel will be often otherwise impossible, but because he knows how much invaluable local information can be only obtained from fishermen, miners, hunters, and tillers of the soil. Next he should be brave and enterprising, and withal patient and undaunted; not merely in travel, but in investigation; knowing (as Lord Bacon might have put it) that the kingdom of Nature, like the kingdom of heaven, must not be taken by violence, and that only to those who knock long and earnestly does the great mother open the doors of her sanctuary. He must be of a reverent turn of mind also, not rashly discrediting reports, however vague and fragmentary; giving man credit always for some germ of truth, and giving nature credit for an inexhaustible fertility and variety, which will keep him his life long always reverent, yet never superstitious; wondering at the commonest, but not surprised by the most strange; free from the idols of size and sensuous loveliness; able to see grandeur in the minutest objects, beauty in the most ungainly; estimating each thing not carnally, as the vulgar do, by its size or its pleasantness to the senses, but spiritually, by the amount of Divine thought revealed to him therein; holding every phenomenon worth the noting down; believing that every pebble holds a treasure, every bud a revelation; making it a point of

conscience to pass over nothing through laziness or hastiness, lest the vision once offered and despised should be withdrawn; and looking at every object as if he were never to behold it again.

Moreover, he must keep himself free from all those perturbations of mind which not only weaken energy, but darken and confuse the inductive faculty; from haste and laziness, from melancholy, testiness, pride, and all the passions which make men see only what they wish to see. Of solemn and scrupulous reverence for truth, of the habit of mind which regards each fact and discovery not as our own possession, but as the possession of its Creator, independent of us, our tastes, our needs, or our vain-glory, we hardly need to speak; for it is the very essence of a naturalist's faculty, the very tenure of his existence; and without truthfulness science would be as impossible now as chivalry would have been of old.

And last, but not least, the perfect naturalist should have in him the very essence of true chivalry, namely, self-devotion; the desire to advance, not himself and his own fame or wealth, but knowledge and mankind. He should have this great virtue; and in spite of many short-comings, (for what man is there who liveth and sinneth not?) naturalists as a class have it, to a degree which makes them stand out most honorably in the midst of a self-seeking and mammonite generation, inclined to value everything by its money price, its private utility. The spirit which gives freely, because it knows that it has received freely; which communicates knowledge without hope of reward, without jealousy and mean rivalry, to fellow-students and to the world; which is content to delve and toil comparatively unknown, that from its obscure and seemingly worthless results others may derive pleasure, and even build up great fortunes, and change the very face of cities and lands, by the practical use of some stray talisman which the poor student has invented in his laboratory;—this is the spirit which is abroad among our scientific men, to a greater degree than it ever has been among any body of men, for many a century past; and might well be copied by those who profess deeper purposes, and a more exalted calling, than the discovery of a new zoophyte, or the classification of a moorland crag.

And it is these qualities, however imperfectly they may be realized in any individual instance, which make our scientific men, as a class, the wholesomest and pleasantest of companions abroad, and at home the most blameless, simple, and cheerful, in all do-

mestic relations; men for the most part of manful heads, and yet of childlike hearts, who have turned to quiet study, in these late piping times of peace, an intellectual health and courage which might have made them, in more fierce and troublous times, capable of doing good service with very different instruments than the scalpel and the microscope.

I have been sketching an ideal: but one which I seriously recommend to the consideration of all parents; for, though it be impossible and absurd to wish that every young man should grow up a naturalist by profession, yet this age offers no more wholesome training, both moral and intellectual, than that which is given by instilling into the young an early taste for out-door physical science. The education of our children is now more than ever a puzzling problem, if by education we mean the development of the whole humanity, not merely of some arbitrarily chosen part of it. How to feed the imagination with wholesome food, and teach it to despise French novels, and that sugared slough of sentimental poetry, in comparison with which the old fairy-tales and ballads were manful and rational; how to counteract the tendency to shallow and conceited sciolism, engendered by hearing popular lectures on all manner of subjects; which can only be really learnt by stern methodic study; how to give habits of enterprise, patience, accurate observation, which the counting-house or the library will never bestow; above all, how to develope the physical powers, without engendering brutality and coarseness,—are questions becoming daily more and more puzzling, while they need daily more and more to be solved, in an age of enterprise, travel, and emigration, like the present. For the truth must be told, that the great majority of men, who are now distinguished by commercial success, have had a training the directly opposite to that which they are giving to their sons. They are, for the most part, men who have migrated from the country to the town, and had in their youth all the advantages of a sturdy and manful hill-side or sea-side training; men whose bodies were developed, and their lungs fed on pure breezes, long before they brought to work in the city the bodily and mental strength which they had gained by loch and moor. But it is not so with their sons. Their business habits are learnt in the counting-house; a good school, doubtless, as far as it goes; but one which will expand none but the lowest intellectual faculties; which will make them accurate accountants, shrewd computers and competitors, but never the origi-

nators of daring schemes, men able and willing to go forth to replenish the earth and subdue it. And in the hours of relaxation, how much of their time is thrown away, for want of anything better, on frivolity, not to say on secret profligacy, parents know too well; and often shut their eyes in very despair to evils which they know not how to cure. A frightful majority of our middle-class young men are growing up effeminate, empty of all knowledge but what tends directly to the making of a fortune; or rather, to speak correctly, to the keeping up the fortunes which their fathers have made for them; while of the minority, who are indeed thinkers and readers, how many women as well as men have we seen wearying their souls with study undirected, often misdirected; craving to learn, yet not knowing how or what to learn; cultivating, with unwholesome energy, the head at the expense of the body and the heart; catching up with the most capricious self-will one mania after another, and tossing it away again for some new phantom; gorging the memory with facts which no one has taught them to arrange, and the reason with problems which they have no method for solving; till they fret themselves into a chronic fever of the brain, which too often urges them on to plunge, as it were to cool the inward fire, into the ever-restless sea of doubt and disbelief. It is a sad picture. There are many who may read these pages whose hearts will tell them that it is a true one. What is wanted in these cases is a methodic and scientific habit of mind; and a class of objects on which to exercise that habit, which will fever neither the speculative intellect nor the moral sense; and those physical science will give, as nothing else can give it.

Moreover, to revert to another point which we touched just now, man has a body as well as a mind; and with the vast majority there will be no *mens sana* unless there be a *corpus sanum* for it to inhabit. And what out-door training to give our youths is, as we have already said, more than ever puzzling. The difficulty is felt, perhaps, less in Scotland than in England. The Scotch climate compels hardiness; the Scotch bodily strength makes it easy; and Scotland, with her mountain-tours in summer, and her frozen lochs in winter, her labyrinth of sea-shore, and, above all, that priceless boon which Providence has bestowed on her, in the contiguity of her great cities to the loveliest scenery, and hills where every breeze is health, affords facilities for healthy physical life unknown to the Englishman, who has no Arthur's Seat tower-

ing above his London, no Western Islands spotting the ocean firths beside his Manchester. Field sports, with the invaluable training which they give, if not

> "The reason firm,"

yet still

> "The temperate will,
> Endurance, foresight, strength, and skill,"

have become impossible for the greater number; and athletic exercises are now, in England at least, so artificialized, so expensive, so mixed up with drinking, gambling, and other evils of which we need say nothing here, that one cannot wonder at any parents' shrinking from allowing their sons to meddle much with them. And yet the young man who has had no substitute for such amusements will cut a very sorry figure in Australia, Canada, or India; and, if he stays at home, will spend many a pound in doctors' bills, which could have been better employed elsewhere. "Taking a walk" as one would take a pill or a draught, seems likely soon to become the only form of out-door existence possible for us of the British Isles. But a walk without an object, unless in the most lovely and novel of scenery, is a poor exercise, and as a recreation utterly nil. We never knew two young lads go out for a "constitutional," who did not, if they were commonplace youths, gossip the whole way about things better left unspoken; or, if they were clever ones, fall on arguing and brainsbeating on politics or metaphysics from the moment they left the door, and return with their wits even more heated and tired than they were when they set out. We cannot help fancying that Milton made a mistake in a certain celebrated passage; and that it was not "sitting on a hill apart," but tramping four miles out and four miles in along a turn-pike road, that his hapless spirits discoursed

> "Of fate, free-will, foreknowledge absolute,
> And found no end, in wandering mazes lost."

Seriously, if we wish rural walks to do our children any good, we must give them a love for rural sights, an object in every walk; we must teach them—and we can teach them—to find wonder in every insect, sublimity in every hedgerow, the records of past worlds in every pebble, and boundless fertility upon the barren shore; and so, by teaching them to make full use of that limited sphere in which they now are, make them faithful in a few things, that they may be fit hereafter to be rulers over much.

I may seem to exaggerate the advantages of such studies; but the question after all is one of experience; and I have had experience enough and to spare that what I say is true. I have seen the young man of fierce passions, and uncontrollable daring, expend healthily that energy which threatened daily to plunge him into recklessness, if not into sin, upon hunting out and collecting, through rock and bog, snow and tempest, every bird and egg of the neighboring forest. I have seen the cultivated man, craving for travel and for success in life, pent up in the drudgery of London work, and yet keeping his spirit calm, and perhaps his morals all the more righteous, by spending over his microscope evenings which would too probably have gradually been wasted at the theatre. I have seen the young London beauty, amid all the excitement and temptation of luxury and flattery, with her heart pure and her mind occupied in a boudoir full of shells and fossils, flowers and sea-weeds, and keeping herself unspotted from the world, by considering the lilies of the field, how they grow. And therefore it is that I hail with thankfulness every fresh book of Natural History, as a fresh boon to the young, a fresh help to those who have to educate them.

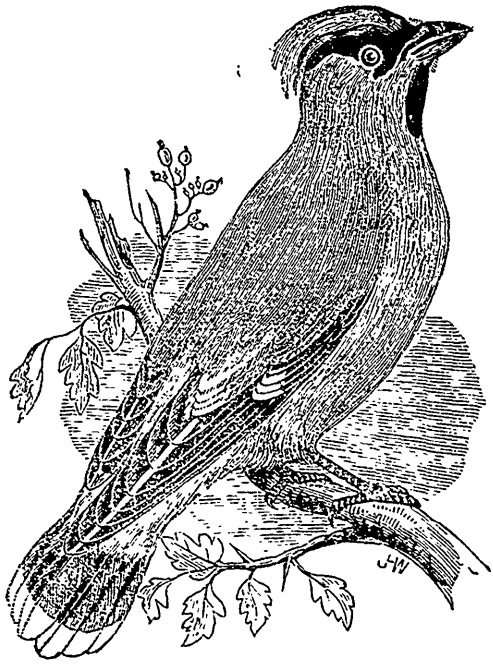
Lawrencian Formation.—This formation was so called by M. Desor, a French Geologist, but as the name has the same sound as Laurention it is not we believe intended to be adopted permanently in this country. Were there no other reason the impossibility of understanding in conversation which of the two might be the subject would of itself be sufficient. But it is not satisfactorily proved as we have before remarked, (337,) that the deposit is distinct from the drift properly so called, and the time therefore has not yet arrived for effecting a separation. It was for this reason that we stated that the Tertiary rocks "are supposed to consist of two divisions." We do not approve of minute subdivisions particularly where as in this case the separation is proposed partly upon negative evidence, i. e., that fossils have not been found in the lower part of the deposit. Several lines of this kind have been already drawn in the geology of North America, and as might be expected are fast fading away before the increasing light of science.

ARTICLE XLII. Notice *of the Occurrence of the Pine Grosbeak and Bohemian Chatterer, near Montreal:* by W. S. M. d'Urban, Esq.

During the severe weather at the beginning of this month I met with a large flock of Pine Grosbeaks, (*Pyrrhula enuncleator.* Selby,) and Bohemian Waxwings, or Chatterers (*Bombycilla garrula.* Flem.) on the Mountain about half a mile beyond the Priest's Farm. They were feeding in company on the berries of the Mountain Ash, and I succeeded in shooting a male and female of the Grosbeaks, but was not so fortunate as to obtain any of the Chatterers. I have, however, seen several specimens, which were shot, lately, near the "back river" by a Canadian, and now in the possession of Mr. Broome, of the Natural History Society. At first they were quite tame, and allowed me to go close to them, but after I had fired at them, they became much more difficult of approach. I found the Grosbeaks for several successive days feeding in the same place, but the Waxwings disappeared after the second day, and I saw no more of them. The red plumage of the Grosbeaks, and the pointed crests and yellow tipped tails of the Chatterers, rendered it easy to distinguish the two species from each other, even at a considerable distance. It had a pretty effect, on a bitter cold day, the Thermometer being some degrees below Zero, to see these beautiful and hardy birds, picking off the bright-red berries, the Grosbeaks clinging back downwards to the branches, like Parrots. It was also peculiarly interesting to an English Ornithologist, to behold two species deemed such rarities at home, feeding in numbers within a few yards of him. The two specimens I shot, when skinned, had a strong odour of Prussic-acid, derived from the pips of the Mountain Ash berries with which their stomachs were crammed, and their throats were full of the pulp and seeds alone, as they dexterously squeeze out the seeds and pulp, rejecting the skins, which are scattered over the snow, in great quantities under the trees where they feed. There was a considerable amount of orange-coloured fat on their bodies, showing that they throve on the fare they had found. The last time I saw the Pine Grosbeaks, was on the 20th, when I observed the flock flying about over the place where I first met with them, and I believe they still continue in the neighbourhood. As far as I

am informed, these two species are rare in this portion of Canada, and I trust this short notice of their occurence here, may not be uninteresting to the Editor of the Canadian Naturalist and Geologist.—*W. S. M. d'Urban, Montreal, 23rd January, 1857.*

Note.—The pine Grosbeak according to Wilson's description, "measures nine inches in length and fourteen in extent; the head, neck, breast and rump are of a rich crimson, palest on the breast; the feathers on the middle of the b ck are centred with arrow shaped spots of black, and skirted with crimson, which gives the plumage a considerable flush of red there; those on the shoulders



European Wax-Wing (*Bombycilla garrula*), male.

are of a deep slate colour, partially skirted with red and light ash. The greater wing coverts and next superior row are broadly tipped with white, and slightly tinged with reddish; wings and tail black, edged with light brown; tail considerably forked; lower part of the belly, ash colour; vent feathers skirted with white, and streaked with black; legs glossy black; bill a brownish horn colour, very thick, short and hooked at the point; the u pper

mandible overhanging the lower considerably, approaching in its form to that of the parrot; base of the bill, covered with recumbent hairs of a dark brown colour. The whole plumage near the roots, as in most other birds, is of a deep bluish ash colour. The female was half an inch shorter, and answered nearly to the above description; only those parts that in the male were crimson were in her of a yellowish colour."

In an interesting paper (on the Land Birds wintering in the neighbourhood of Toronto, by G. W. Allan, Esq.,) read before the Canadian Institute in 1853, it is stated that this species visited the vicinity of that city in 1839, in large flocks. In 1836 they were shot so far south as Philadelphia. It is a constant resident however in the cold regions of the Hudson's Bay territory, and is only seen in the inhabited southern border of Canada in very cold winters.

This bird is said to be a charming songster, Wilson kept one of them in a cage for more than half a year, and he remarkes that in May and June its song, though not so loud as some birds of its size, was extremely clear, mellow and sweet. It would warble out this for a whole morning together, and acquired several notes of the red bird that hung near it.

Bombycilla garrula. This bird very much resembles the common Wax-wing or cedar bird, sometimes also called the cherry bird in this country. From the account which follows it will be seen, however, that this species is different and has a very wide geographical range, being an European as well as an American bird. On this continent it breeds in the northwest, and only visits us in cold winters.

The following description is from the English Cyclopaedia:

B. garrula, European Wax-Wing or Chatterer. This elegant species, which is also known by the English names of the Bohemian Chatterer, Bohemian Wax-Wing and Silk-Tail, is Le Jaseur de Bohême, (Buffon, &c.), Grand Jaseur (Temminck), and Geay de Bohême of the French; Garrulo di Boemia of the Italians; Rothlichgrauer Seidenschwantz (Meyer), Europaischer Seidenschwanz, and Gemeine Seidenschwanz (Bechstein) of the Germans; *Garrulus Bohemicus* of Gesner; *Bombycilla* of Schwenok; *Ampelis* of Aldrovand; *Bombycilla Bohemica* of Brisson; *Ampelis garrulus* of Linnæus; *Bombyciphora garrula* of Brehm; *Bombyciphora poliocœlia* of Meyer; *Bombycivora garrula* of Temminck; and *Bombycilla garrula* of Vieillot.

In addition to the nomenclature above given, the bird is said to be named by the Italians in some localities Becco-Frisone, in others, Galletto del Bosco; and by the bird-catchers of Bologna, Uccello del Mondo Novo; by the Germans, Zinzerelle, Wipstertz, Schenee-Vogel and Schenee-Leschke, and by those in the neighbourhood of Nürnberg, Beemerlee and Behemle; by the Swedes, Siden-Swantz; and by the Bohemians, Brkoslaw.

That the Bohemian Chatterer was known to the ancients there can be little doubt; but a great deal of obscurity prevails as to the names by which it was distinguished. Some have taken it to be the *Incendiaria Avis* of Pliny (book x. c. 13), the inauspicious bird, on account of whose appearance Rome more than once underwent lustration, but more especially in the consulship of L. Cassius and C. Marius, when the apparition of a great owl (*Bubo*) was added to the horrors of the year. Others have supposed that it was the bird of the Hercynian forest (book x. c. 47), whose feathers shone in the night like fire. Aldrovandus, who collected the opinions on this point, has taken some pains to show that it could be neither the one nor the other. The worthy Italian gravely assures his readers that its feathers do not shine in the night; for he says he kept one alive for three months, and observed it at all hours ("quâvis noctis horâ contemplatus sum.")

It is by no means improbable that this bird was the gnaphalos of Aristotle ('Hist. Anim.,' book ix. c. 16).

The geographical range of the Bohemian Chatterer is extensive, comprehending a great portion of the arctic world. It appears generally in flocks, and a fatality was at one time believed to accompany their movements. Thus Aldrovandus observes that large flights of them appeared in February, 1530, when Charles V. was crowned at Bologna; and again in 1551, when they spread through the duchies of Modena, Piacenza, and other Italian districts, carefully avoiding that of Ferrara, which was afterwards convulsed by an earthquake. In 1552, according to Gesner, they visited the banks of the Rhine, near Mentz, in such myriads that they darkened the air. In 1571 troops of them were seen flying about the north of Italy, in the month of December, when the Ferrarese earthquake, according to Aldrovandus, took place, and the rivers overflowed their banks.

Necker, in his Memoir on the Birds of Geneva, observes that from the beginning of this century only two considerable flights have been observed in that canton, one in January, 1807, and the other in 1814, when they were very numerous, and having spent

the winter there, took their departure in March. In the first of those years they were scattered over a considerable part of Europe, and early in January were seen near Edinburgh. Savi observes that they are not seen in Tuscany except in very severe winters, and that the years 1806 and 1807 were remarkable for the number of them which entered Piedmont, especially the valleys of Lanzo and Suza.

It has been said that it is always rare in France, and that of late years it has become scarce in Italy and Germany; but Bechstein observes that in moderate seasons it is found in great flights in the skirts of the forests throughout the greater part of Germany and Bohemia, and that it is to be seen in Thuringia only in the winter: if the season be mild in very small numbers, the greater portion remaining in the north; if the weather be severe, it advances farther south.

The Bohemian Chatterer must be considered only as an occasional visitant to the British Islands, though Pennant says that they appear only by accident in South Britain, but that about Edinburgh they come annually in February, and feed on the berries of the mountain ash; adding that they also appear as far south as Northumberland, and like the fieldfare make the berries of the white thorn their food; he records the death of one which was killed at Garthmeilio in Denbighshire in a fir-tree during the severe frost of December, 1788. Latham, in a note to this statement, says that the late Mr. Tunstall informed him that in the winter of 1787 many flocks were seen all over the county of York, and that towards the spring a flock of between twenty and thirty were observed within two miles of Wycliffe, his place of residence. Bewick states that in the years 1790, 1791, and 1803 several of them were taken in Northumberland and Durham as early as the month of November. Selby says that in the winter of 1810 large flocks were dispersed through various parts of the kingdom, and that from that period it does not seem to have visited our island till the month of February, 1822, when a few came under his inspection, and several were again observed during the severe storm in the winter of 1823. Montagu says that he received it out of Staffordshire, and that he has known others killed in the more southern counties in the autumn and winter. In Mr. Rennie's edition of the 'Ornithological Dictionary' (1833) it appears that one had been shot in the park of Lord Boringdon at Saltram in Devonshire, and that not less than twenty had been killed in the counties of Suffolk and Norfolk during the last three winters.

Graves says that about Christmas, 1803, a number were shot in the neighbourhood of Camberwell, from one of which, being but slightly wounded, his figure was taken. In 'Loudon's Magazine' it is stated that a fine specimen was shot near Coventry in December, 1830, where it appeared to associate with starlings, and that during the same month of the same year six were killed in the vicinity of Ipswich. The late Mr. W. Thompson records various instances of the occurrence of this bird in Ireland. In the British Islands it more frequently occurs in the north than the south, and Mr. Yarrell states that "the winters of 1787, 1788, 1789, 1790, 1791, 1803, 1810, 1820, 1822, 1828, 1830, 1831, 1834, and 1835, are particularly recorded as having afforded opportunities of obtaining specimens in some one or other of various northern localities."

Although called the Bohemian Wax-Wing, it is not more common in Bohemia than England. In the central and southern parts of the European continent it is only an occasional visitor.

In northern Russia and the extreme north of Norway, according to C. L. Bonaparte, they are seen in great numbers every winter, being observed there earlier than in temperate countries. In northern Asia and Eastern Europe their migrations are tolerably regular. Very numerous flocks pass through Scania in November, and are again seen on their return in the spring.

But the species is not confined to Europe and Asia. "By a singular coincidence," says the Prince of Canino, "whilst we were proclaiming this species as American, it was received by Temminck from Japan, together with a new species, the third known of the genus." He says that his best specimen was shot on the 20th of March, 1825, on the Athabasca River, near the Rocky Mountains; and observes that the species appears to be spread widely, as he had been credibly informed by hunters that "cedar-birds of a large kind" had been shot a little beyond the Mississippi; adding that he is at a loss to conceive why it should never have been observed on this side of the last-mentioned river. Mr. Drummond in the spring of 1826 saw it near the sources of the Athabasca, and Sir John Richardson observed it in the same season at Great Bear Lake in lat. 65°, where a male, of which he gives a description, was shot on the 24th of May of that year. He also says that he observed a large flock of at least three or four hundred on the banks of the Saskatchewan, at Carlton House, early in May, 1827. They alighted in a grove of poplars, settling all on one or two trees, and making a loud twittering noise.

They stayed only about an hour in the morning, and were too shy to allow him to approach within gunshot.

The district where these birds breed is unknown. Bechstein says that it does not build in Germany when wild, but within the Arctic Circle.

Bonaparte gives a very amiable character of the European Wax-Wing in a state of nature, attributing to them a particular sentiment of benevolence, even independent of reciprocal sexual attraction. "Not only," says the Prince, "do the male and female caress and feed each other, but the same proofs of mutual kindness have been observed between individuals of the same sex." Speaking of their habits he says, "They always alight on trees, hopping awkwardly on the ground. Their flight is very rapid: when taking wing they utter a note resembling the syllables zi, zi, ri, but are generally silent notwithstanding the name that has been given them." Bechstein says, "When wild we see it in the spring eating, like thrushes, all sorts of flies and other insects; in autumn and winter, different kinds of berries; and in time of need, the buds and sprouts of the beech, maple, and various fruit-trees." Willoughby states that it feeds upon fruit, especially grapes, of which it is very greedy. "Wherefore it seems to me," he adds, "not without reason, to be called by that name *Ampelis*." Bonaparte makes their food to consist of different kinds of juicy berries, or of insects, observing that they are fond of the berries of the mountain-ash and *Phytolacca*, and that they are extremely greedy of grapes, and also, though in a less degree, of Juniper and laurel-berries, apples, currants, figs, and other fruits. He adds that they drink often, dipping their bills repeatedly.

In captivity its qualities do not appear to be very attractive, according to Bechstein, who says that nothing but its beauty and scarcity can render the possession of it desirable, for that it is a stupid and lazy bird. Indeed he draws such a picture of its greediness and dirty habits, that, if it be not overcharged, few we should think would wish to have it as an inmate. Leaving out the more unpleasant parts of his description, we take the following extract from his 'Cage Birds':—"During the ten or twelve years that it can exist in confinement, and on very meagre food, it does nothing but eat and repose for digestion. If hunger induces it to move, its step is awkward, and its jumps so clumsy as to be disagreeable to the eye. Its song consists only of weak and uncertain whistling, a little resembling the thrush, but not so

loud. While singing it moves the crest, but hardly moves the throat. If this warbling is somewhat unmusical it has the merit of continuing throughout every season of the year. When angry, which happens sometimes near the common feeding-trough, it knocks very violently with its beak. It is easily tamed." The same author says, that in confinement the two universal pastes appear delicacies to it; and it is even satisfied with bran steeped in water. It swallows everything voraciously, and refuses nothing estable, such as potatoes, cabbage, salad, fruit of all sorts, and especially white bread. It likes to bathe, or rather to sprinkle itself with water, for it does not wet itself so much as other birds.

It is taken in nooses, to which berries are fixed, which for this purpose, says the author last quoted, " should always be kept in store till February. It appears to be frightened at nothing, for it flies into nets and traps, though it sees its companions caught, and hanging and uttering cries of distress and fear."

Length about eight inches; the size altogether approaching that of a starling.

Male. Bill strong, black, except at the base, where the colour inclines to a yellowish-white; nostrils hidden under small black feathers. Irides purplish-red. Chin and throat velvety black, as is also the streak (in the midst of which is the eye) passing from the bill to the hinder part of the head. Fore-head reddish-brown. Head feathers long, silky, forming a reclining crest approaching to reddish-chesnut, which the bird can erect or depress at pleasure. Upper parts purplish-red, or vinaceous-brown dashed with ash-colour, the rump-lightest. Breast and belly pale purplish-ash, tinged with pale brownish-red. Vent and under tail-coverts orange-brown inclining to reddish-orange. Greater wing-coverts black, tipped with white. Lesser wing-coverts of a shade darker than the general tint of the upper plumage. Primaries black, with a bright yellow spot near the white tips of their outer webs. Montagu says that the three first are tipped with white, and the others with yellow on their outer margins. Secondaries gray, tipped with white on the outer web, and seven or eight of them terminated with small flattish, oval, horny appendages, of the colour of red sealing-wax. Sometimes there are not more than 5 or 6 of these wax-like tips, and in Montagu's specimen there were 5 on one side and 6 on the other. Graves gives the number at from 6 to 9 (Bechstein at from 5 to 9,) and mentions the specimen in Mr. Haworth's collection, which had some on the tail, which is black tipped with yellow, and dashed with ash-colour at the base. Shanks, toes, and claws, black.

ARTICLE XLIII.—*Fossils of the Hamilton Group.*

The following description of the fossils represented on the plate, and by the accompanying wood cuts are from the geology of New York, by Professor Hall. Many of them will be found in the western part of Upper Canada, where the Hamilton group occurs.

Fig. 1. *Cucullea opima.* "Ovate, very convex; beaks near the anterior extremity, very prominent; surface marked by strong concentric lines; cast nearly smooth; impression of the internal laminae, oblique. When compressed this fossil has the appearance of a *Nucula*, but the impressions of the internal laminae seem sufficient to warrant its reference to *Cucullea.*"

The generic name is from the Latin, *Cucullus*, a hood; the name is probably from *opimus*, fat, or well grown.

Fig 2. *Nucula oblonga.* "Oblong, elliptical, very inequilateral, very finely and concentrically striated; an impressed line extends from the hinge, just forward of the beak, half way to the base."

Generic name from the Latin, *Nucula* a little nut; *Oblongus*, oblong.

Fig. 3. *Nucula lineata.* "Sub-triangular, convex; beak much elevated; surface covered with coarse concentric striæ."

Lineata, covered with lines or striæ.

Fig 4. *Cypricardia truncata* (Conrad.) "Trapezoidal, surface covered with concentric wrinkles; posterior slope sharply carinated. The wrinkles on the posterior slope are parallel to the truncated margin and nearly at right angles with those upon the side of the shell."

The generic name is from the Greek, *Kuprinos*, related to the goddess Venus, and *Kardia*, the heart; *truncata*, latin, truncated or abruptly cut off.

Fig. 5. *Tellina ovata.* "General form ovate, produced posteriorly and apparently slightly gaping at the extremity; posterior slope angulated; surface covered by minute concentric striæ, which become more prominent near the margin."

Generic name from the Greek, *telline*, a sort of mussel, *ovata*, oval or eggshaped.

Fig 6. *Nucula bellatula.* "Ovate, somewhat contracted near the posterior extremity; surface covered with regular, fine concentric striæ; teeth in the hinge margin very distinct; there is a

slight depression extending along the posterior slope, giving a contracted appearance to this part of the shell."

The specific name appears to have been derived from the Latin, *bellus*, pretty.

Fig. 7. *Modiola concentrica.* "Oblong-ovate, very inequilateral; surface covered with regular, equal concentric striæ, which become confluent towards the base; hinge line curved; anterior side short, with a longitudinal impression directly below the beaks."

Generic name from the Latin, *modiolus*, a small measure or drinking vessel.

Fig. 8. *Turbo lineatus.* "Turbinate obtuse; surface marked by several sharp spiral lines, all which, except the central one, are not visible on the cast; longitudinally striated, last whorl of the shell rapidly expanding; aperture orbicular; umbilicus moderate."

Turbo Latin, a top, *lineatus*, covered with lines.

Fig. 9 & 10. *Spirifer mucronatus.* "Varying in form from semicircular to triangular, with the hinge line greatly extended; surface marked by 24 to 30 rounded ribs, which are crossed by crowded undulating lamellæ, giving a squamous appearance to the shell hinge; area very narrow; aperture small.

Fig. 9 is the nearly semi-circular form; Fig. 10 shews the hinge line more extended. "This is a very ornamental shell, and its numerous varieties in form are very interesting. In the soft calcareous shales of Western New York, it is shorter and more rotund, while in the sandy shales and shaly sandstones of the middle and eastern part of the State, it is greatly extended, and its extremeties very acute. Occurs in all the localities of the upper middle portion of the group."

Spirifer, from the Latin *spira*, a spire, and *fero*, I bear; *mucronatus*, sharp pointed. This shell occurs abundantly in the formation in western Canada.

Fig. 11. *Atrypa prisca.* "Oblong, often nearly circular; lower valve least convex, with the beak scarcely prominent, and pressed close to the beak of the upper valve; upper valve very convex; front margin often advanced and a little depressed; surface radiated with numerous round striæ, which bifurcate at irregular intervals." "The specimens vary in size, and frequently are flattened from compression, so that they do not present the rotund form of the figure.

Generic name from the Greek *a*, without, and *trupa*, a perforation; *prisca*, old, ancient.

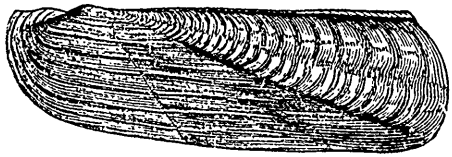


Fig. 12. *Orthonota undulata.*

Fig. 12. *Orthonota undulata.* Professor Hall says this fossil is more common in the eastern part of the State of New York than in the western. It may yet be found in Canada, and therefore we publish it here.

Orthonota, from the Greek *orthos*, straight, and *notatus*, marked.

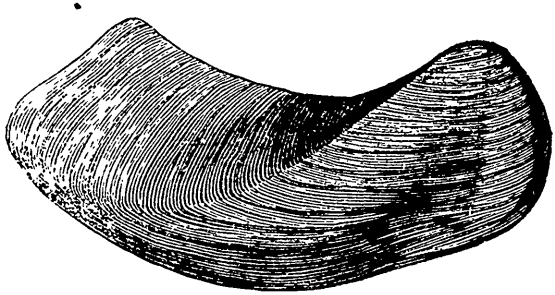


Fig. 12. *Cypricardia recurva.*

Fig. 12. *Cypricardia recurva* is given by Mr. Vanuxem, as being a common fossil of this group of rocks. It is remarkable for its curved form: hence the specific name.

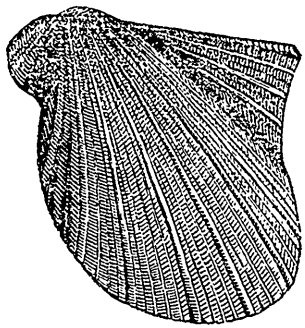


Fig. 13. *Avicula flabella.*

Fig. 13. *Avicula flabella* is another of Vanuxem's fossils, belonging to the Hamilton rocks.

The generic name is Latin, *Avicula*, a little bird; specific name *flabella*, a little fan.

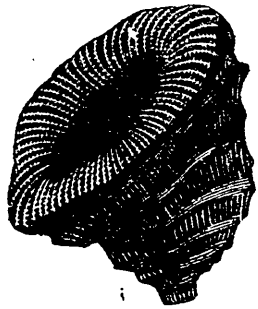


Fig. 14. *Heliophyllum Halli*, (Edwards & Haime.)

Fig. 14. *Heliophyllum Halli.* This species was described in the New York Reports under the name of *Cyothophyllum turbinatum*, but in a splendid work lately published in France,* wherein all the fossil corals then known of the palæozoic rocks are reviewed it is republished with the above new generic and specific appellations. We translate the description of the learned authors.

"Coral turbinated or cylindro-conic, in general somewhat lengthened and feebly curved at the base; covered by an epitheca, and presenting moderate concentric folds. Cup circular, moderately deep; one small septal fossette (a small cavity or furrow in one side of the bottom of the cup); radiating lamellæ very thin, regular; larger above, where they are rounded, denticulated on their free sides, alternately a little inequal; a little twisted towards the centre; they are 80 in number, or sometimes more. In a vertical section it is seen that the lateral prolongations of the lamellæ are arched and ascending; those which occupy the upper part of the chambers terminate at the free sides of the lamellæ; those which are situated lower unite in the centre to form irregular transverse septa; these prolongations, which close incompletely the interseptal spaces, are distant from each other a little more than a millemetre, and are united by simple cross pieces at right angles."

The generic name is from the Greek *Helios*, the sun, and *phyllon*, a plant. The specific name was given in honor of Professor Hall.

* *Polypiers fossiles des terrains palæozoiques (Fossil corals of the palæozoic formations,) par M. Edwards et J. Haime.*

Fig. 15 *Cystiphyllum Americanum*, (Edwards & Haime.)

Fig. 15 *Cystiphyllum Americanum.* "Coral elongated, cylindro-turbinate, straight or slightly curved, covered by a thin epitheca, and presenting folds of growth more or less marked. When the epitheca is removed, the striæ of very thin ribs may be observed. These are equal in size, and straight. The cup is circular, margins thin, excavated; septal rays distinct and prolonged to the centre under the form of fine striae; about one hundred may be counted. A verticle section shews a tissue entirely vesicular but which is very dense in the external parts of the fossil; the vesicles occupying the outside are in general small and oblique sloping inwards and downwards; those in the centre are larger, a little unequal, and almost horizontal, broader than high, the largest are three millemetres (about one eighth of an inch) in length and 1 or 1½ millemetres in heighth; the small ones are only about one millemetre in breadth."

This species is the *C. cylindricum* of the New York reports. It occurs abundantly in the Hamilton Group in Western Canada. The star shaped mark near the centre of the figure is the base or root of a small encrinite which had attached itself to the specimen figured by Prof. Hall after the death of the coral.

The generic name is derived from the Greek *kustis*, a vesicle, or small cavity. Fossils of this genus when cut and polished, or when their internal arrangement is otherwise exposed, do not exhibit the regularly radiated structure of *Streptelasma*, but consist altogether of vesicular structure. This species is usually four inches or less in length and 1 or 1½ in diameter.

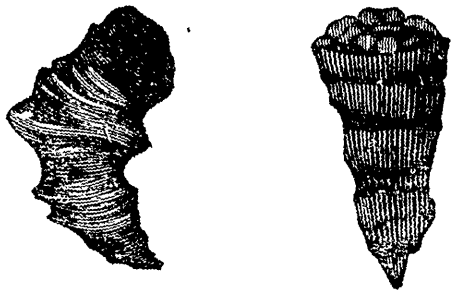


Fig. 16. *Cyathophyllum distortum* (Hall)
Fig. 17 *Cyathophyllum rectum* (Hall.)

Fig. 16 *C. distortum.* "Coral elongated irregularly cylindro-turbinate, a little curved. Epitheca strong; folds of growth very much projecting and sharp-edged; radiating lamellae 26 to 34 in the adults. The general form varies greatly, some specimens are slender and long, others thick and short."

The length of this species is from one to two inches, diameter $\frac{1}{4}$ to $\frac{2}{5}$ of an inch. It is remarkable for the sharp inflections occasionally exhibited, some of the specimens are bent almost at a right angle. Abundant in western Canada.

Cyathophyllum from the Greek *knathus*, a cup.

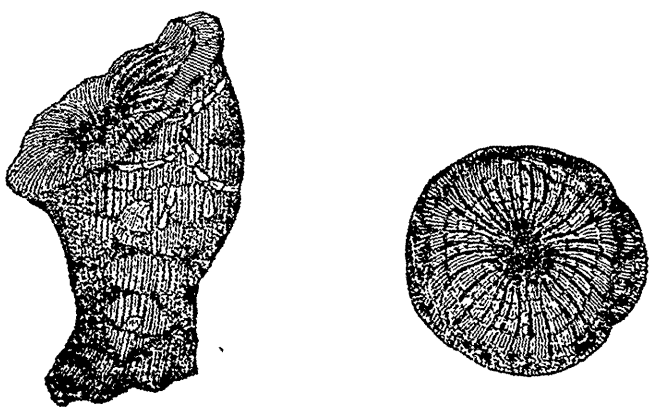


Fig. 18. *Strombodes simplex*, (Hall.)
Views of side and interior of the cup.

Fig. 17. *C. rectum.* "Coral turbinated, elongated, straight, or slightly curved; folds of growth very feeble; ribs simple, rather large, straight, sub-equal, corresponding to the interseptal spaces,

the distinct furrows on the sides indicate the outer edges of the lamellae; the other less distinct furrows the edges of the rudimentary lamellae."

Length from 1 to 2 inches, diameter $\frac{2}{3}$ of an inch.

Specific name, Latin, *rectum*, straight.

Fig. 18. *Strombodes simplex.* Professor Hall thus describes this species. "Turbinate, curved near the base; disk expanded; thin on the edge, sometimes sub-reflexed; laminæ simple, much contorted in the centre, and irregularly bifurcating toward the margin (about 40 in number); surface marked by longitudinal striæ." "The simple prominent laminæ, and shallow cup, at once distinguish this species. It resembles the *S. plicatum* which occurs in the corniferous limestone."

The French authors appear to think this fossil to be a *cyathophyllum*, but do not give any decided opinion.

GAS *for illumination from the Utica slate. Professor Hind's Lecture before the Mechanics' Institute of Toronto, extracted from the Toronto Times, 28th January*, 1857.

"Last Friday evening, Professor Hind, of Trinity College, delivered his second lecture at the St. Lawrence Hall, before the members of the Toronto Mechanic's Institute.

"The lecture was a continuation of a former one, delivered the Friday previous. In describing the manufacture of illuminating gas, the lecturer illustrated the subject by a novel mode of preparing that useful and important means of obtaining artificial light, which we shall endeavour to describe.

"The lecturer exhibited before the audience the process of manufacturing coal gas for illuminating purposes, but the material he employed for generating the gas was a substance altogether different from coal, being nothing more than the bituminous shale, which is found in abundance at the base of the Blue mountains, near Collingwood. This shale extends from lake Ontario at Oshawa, to Collingwood on Georgian Bay. It is particularly rich in bitumen, and produces upon distillation, a very brilliant illuminating gas, together with tar and oils and other substances usually produced in making gas from ordinary coal. The apparatus employed by the lecturer, consisted of a small table furnace, in which was placed an iron retort, containing about half a pound of the shale broken up into small fragments. To the pipe leading from the retort, a small glass globe was attached, for receiving the tar and oil; from this receiver a glass tube led into a vessel containing lime water, through which the gas issuing from the

shale in the red-hot retort was transmitted. To the same vessel a pipe and jet were fixed for burning the gas. Its illuminating power appeared to be greater than that from coal gas, and the lecturer stated that, while the London (England) gas contained on an average not more than from four to six per cent, of the illuminating principle which is called olefiant gas, and very good gas rarely possessed more than ten to twelve per cent, of its valuable constituent; this gas from the bituminous shale of Collingwood or Oshawa, held fifteen per cent, of the illuminating principle in the samples of gas which he had made and examined. The shale varies in the amount of bitumen it contains, so that the strength of the gas is not always the same. A valuable property of the Collingwood shale is that it does not swell or expand upon being heated, like bituminous coal, so that a retort may be filled with it, while it is well known, that it is not safe to fill a retort more than two-thirds of its capacity with bituminous coal. The Lecturer considered it possible that the shales of Collingwood and Oshawa may yet become of economic value, for the purposes of gas-lighting. Similar shales, but of very different geological age, are found in great abundance in the valley of the Sydenham and the Thames rivers near Chatham, and throughout the country between lake Huron and lake Erie, drained by those rivers.

"The geological name of the Collingwood and Oshawa shales was said to be "the Utica slate," and those of the western part of Canada, "the Hamilton shales."

"The lecturer also exhibited the mode of ascertaining the presence of noxious impurities in illuminating gas, and showed the absence of such impurities in the Toronto gas, by illustrative experiments. The tests for sulphuretted hydrogen and sulphurous acid, established conclusively that our Toronto gas, as then taken from the pipes in the St. Lawrence Hall, is perfectly free from those noxious impurities. The lecturer further expressed his opinion, that in isolated factories, and even in private families in the country, gas illumination from fat and oil, or other similar substances would soon become by no means uncommon. The apparatus is extremely simple and cheap, and attended with very little trouble, while the cost of lighting a large building or private house, when compared with candles or oil, was very trifling. The only objection that could be urged against its introduction in or near a private house, was the smell occasioned by the formation of volatile compounds of Carbon and Hydrogen, which chemists had not succeeded in separating by economical processes from common gas.

"The possibility of the economical manufacture of illuminating gas from our Collingwood, Oshawa, and Western shales, is a very interesting and important question, as many cubic miles of those shales, very rich in bitumen are found in Western Canada. Professor Hind also stated that the other products of the distillation of the shales, such as oil, tar, and naptha, are likely to be valuable. We hope we shall hear more of this subject, and that experiments will be set on foot to ascertain the commercial value of the Canadian rocks to which Professor Hind has now called the attention of the members of our flourishing Mechanic's Institute."