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THE
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ARTICLE XXVIII.—*On the Natural History of the Salmon, (Salmo salar,) with remarks upon its economical importance and preservation; By FRANK FORELLE. Written for the Canadian Naturalist and Geologist.*

SAINT CATHERINES, C.W., JUNE, 1856.

The Salmon is a fresh-water fish. It passes the whole of the first year of its life and two-thirds of every other in the fresh water, making annual and sometimes bi-annual migrations to the sea. It may be that we do not yet fully know why they make these visits to the sea, but their chief object seems to be food of different quality and perhaps greater quantity than can be found in fresh water. This opinion is based upon the fact that after its first year the Salmon never increases in size while in fresh water; but, on the contrary, diminishes gradually every day, both in muscle and fat, after coming from the ocean.

There is no fish that in beauty or flavor can compare with a Salmon when fresh from the sea, for then he is in the highest condition, and may be well esteemed by both sportsman and epicure as the king of fishes. At this time, the color along the back is a bluish black, with green reflections, which diminishes in intensity as it approaches the lateral line; below this, it is a clear silvery white. The head is somewhat darker than the back. The dorsal, pectoral, and caudal fins are a dusky black, the ventrals are light-colored, and the anals are silvery white, like the belly. There are usually a

few dark spots on the gill covers, which extend along the lateral line through the entire length of the body. These are most conspicuous in the females. The fins are then soft and the sides and belly covered with sea-lice.

As spawning time approaches and the fish seek the swift, shallow waters at the head of the streams, considerable changes take place in their appearance. The male assumes the appearance known in England as "Red" fish. The sides take on an orange hue, paling into yellow on the belly, the spots become of a bloody-red, and are seen on the dorsal and caudal fins; the back becomes greenish, and the cheek is striped with orange. The lower jaw also elongates into a hooked cartilaginous excrescence, which fits into the upper. The females grow darker, particularly upon the back, fins, and gill-covers, and are now called "Black" fish.

After spawning they are lank and lean, with heads much larger in proportion to their bodies. The females change to a greyish color on the back and yellow on the sides, with red and dusky spots alternating above the lateral line, and extended upon the dorsal and caudal fins, while the pectoral, ventral, and anal fins become of a blueish grey. They are now called Kelts.

In the classification given on the thirtieth page of this magazine, the Salmon belongs to the order called Cycloids; in the system heretofore in use, it falls under the order of soft-rayed abdominal fishes; family Salmonidæ, genus *Salmo*: specific name, *Salmo salar*.

The body is covered with thin oval scales, but the head is smooth or free from scales. There are two dorsal fins, the first with thirteen rays, the second fatty, long and rounded, and without any rays. The pectoral fins have twelve rays, and the ventral nine, the anal fin nine, and the caudal nineteen. The head is one-fifth of the whole length of the fish, the eyes are small, and the nostrils are placed much nearer to the eyes than to the point of the nose. The lateral line is straight, and runs very nearly through the centre. In adults, the caudal fin is lunated, but in the young fish it is considerably forked. The branchiostegous rays, or bony rays of the gill-covers, are usually from ten to twelve, but are not always the same on both sides. It has strong sharp teeth on all the maxillary and both palatine bones; there are one or two teeth, rarely more than two, and frequently but one, on the vomer, and three to five on the tongue.

Such are some of the leading features by which this beautiful fish may be distinguished, beautiful indeed, whether it swims in its native element, its sides sparkling like molten silver, or smoking on the table it graces the beginning of the feast.

As soon as the rivers are free from ice, say from the middle of May to the first of June, the Salmon, grown fat and silvery on their sea-found food, appear in the Estuaries, where they usually remain for a time, going up with the flood and returning with the Ebb. In those rivers of Great Britain which run clear as early as February, they have been observed to make a second migration to the sea before running up to spawn. I am not informed whether this has been observed in any of the Salmon rivers of the Provinces,

but am disposed to believe that in as much as the season is so far advanced before our rivers are free from ice, they seldom, if ever, make a second migration to the sea in the same year.

It seems that they remain for a time in the brackish waters as a preparatory step to their approaching inland journey. When they first come from the sea, as has been observed, they are fat and heavy, their sides are covered with sea-lice, and their fins are soft from the action of the salt water. By remaining a short time in the fresher water of the Estuaries, they rid themselves of the sea-lice, gradually lose something in weight and fatness, and their fins becoming hardened, are more capable of sustaining them in their often long and laborious ascent, while the fish themselves become proportionably more active and muscular.

About the end of July they begin to ascend the rivers, seeking the spot where they were born and where they passed the first year of their life.—With a strength and velocity almost incredible, they stem the most powerful current and shoot up the swiftest rapids; nor do cascades always present insuperable obstacles; up these they frequently leap with astonishing vigor, and though they fail in their first attempts by no means are they discouraged, but resting awhile at the foot to recruit their strength, they try again and again, until the feat is accomplished, and they reach the top of their mountain stream.

The height to which Salmon can leap is stated variously. Scrope (*Days and Nights of Salmon Fishing*.) says that six feet in height is more than the average leap of the Salmon, while very large fish, he thinks, could in deep water leap much higher. Ephemera, in *Bell's Life in London*, Jan. 4, 1854, seems to doubt whether the Salmon can leap *much* higher than six feet. Moses H. Perley, whose accurate observations have thrown much light upon the Natural History of our Fishes, say they frequently leap falls ten and twelve feet in height, and that "it is believed the utmost limit of perpendicular height which a Salmon can attain in leaping is fourteen feet." Wm. H. Herbert, in his very interesting work on the Fish and Fishing of America, says, "I once watched a Salmon for above an hour endeavouring to pass a mill dam on the river Wharfe, a Salmon river in the West Riding of Yorkshire. The dam was of great height, 13 or 14 feet at least, and was formed with a sort of step midway, on which the water fell, making a double cascade. While I was watching him, this fish, which was, I suppose, of some seven or eight pounds, made above twenty leaps, constantly alighting from his spring about midway the upper shoot of the water, and being constantly swept back into the eddy at its foot. After a pause of about a couple of minutes, he would try it again, and such were his vigor and endurance, that he at last succeeded in surmounting the formidable obstacle."

The old fable, that in making these leaps the Salmon take their tails in their mouths and rise by the force of the spring, like an Elastic bow, has been long exploded, and I was much surprised to find a writer in *Putnam's Monthly* for March, 1855, gravely repeat the silly tale. Scrope says "they rise very rapidly from the very bottom to the surface of the water by means

of rowing and sculling, as it were, with their fins and tail; and this powerful impetus bears them upwards in the air, on the same principle that a few tugs of the oar make a boat shoot outwards after one has ceased to row."—Ephemera says, "the ascending motion is caused by the Salmon striking the water downwards with its pectoral, ventral, and dorsal fins, aided by bodily muscular action." There is no doubt this muscular exertion often gives to the fish, its curvilinear form.

The Salmon do not breed in lakes, nor ponds, nor any deep or still water. It is only in the shallows, where the waters run clean and swift over gravelly and sandy bottoms, that they deposit their eggs. It is for this that they seek the heads of the streams, shooting up the rapids and leaping the water falls, counting no exertion nor fatigue too great, if they may but safely deposit the hopes of future years where the highly aerated waters rippling over their procreant cradle, may quicken the embryo Salmon into life.

In the ascent, the females lead the way. After reaching the river sources, when the water has cooled to about 42° Fahrenheit, they prepare to deposit their spawn. By this time the male and female have put on respectively the appearance known as "Red" fish and "Black" fish. The female seek out their mates, and pairing off, they choose a spawning place, from which, if possible, they drive away all other fish. Ephemera, describing the manner in which they deposit their eggs, says, "a Salmon spawning-bed is constructed thus:—The fish having paired, chosen their spot for bed-making, and being ready to lie-in, they drop down a stream a little, and then rushing back with velocity towards the spot selected, they dart their heads into the gravel, burrowing with their snouts into it. This burrowing action, assisted with the powers of the fins, is performed with great force, and the water's current aiding, the upper part or roof of the excavation is removed. The burrowing process is continued, until a first nest is dug sufficiently capacious for a first deposition of ova. Then the female enters this first hollowed link of the bed and deposits therein a portion of her ova. That done, she retires down stream and the male instantly takes her place, and pouring, by emission, a certain quantity of milt over the deposited ova, impregnates them. After this, the fish commences a second excavation immediately above the first, and in a straight line with it. In making the excavations they relieve one another. When one fish grows tired of its work it drops down stream until it is refreshed, and then with renovated powers resumes its labors, relieving at the same time its partner. The partner acts in the same spirit, and so their labor progresses by alternate exertion. The second bed completed, the female enters it as she did the first, again depositing a portion of ova, and drops a little down stream. The male forthwith enters the excavation, and impregnates the ova in it. The different nests are not made on the same day, but on different days, progressively. The ova in the first nest are covered with gravel and sand dug from the second, being carried into it chiefly by the action of the current. The excavating process just described is day by day continued until the female has no more ova to deposit. The last deposition of ova is covered in by the action of the fish and water,

breaking down some of the gravel crust above and over the nest. Thus is formed a complete spawning bed, not at once, not by a single effort, but piecemeal, and at several intervals of greater or less duration, according to the age and size of the fish and quantity of ova to be deposited." They are usually occupied from five to ten days.

When this task is accomplished they descend the stream to the nearest pool and there remain awhile to recruit. They are now Kelts, and unfit to be eaten. After they have somewhat recovered from the exhausting process of spawning, they proceed slowly down stream to the tide waters, where they linger a time before going out to their ocean feeding grounds. In Great Britain it has been observed that these streams which empty into a sea having a north and south direction, the Salmon, on returning, swim northward. It was long a matter of inquiry what they fed upon at sea. Upon opening their stomachs, Sir Humphrey Davy found only a little yellow fluid, and the parastical worms which bred there. That they found food of some kind, and that in great abundance, was well proved by their coming back in a few months so much increased in flesh and flavor. The microscopical observations of Dr. Knox have shewn that their sea food consists of the eggs of Echinodermata and Crustacea.

Let us now go back and look after the Salmon eggs which we left buried up in the sand and gravel at the bottom of the stream. Careful observations and experiments recently made in Great Britain, have disclosed many important particulars relating to the hatching and growth of the young Salmon. It has been ascertained that the time between the deposition of the ova and the appearance of the little fish varies with the temperature of the water. When the water is at 36° Fahrenheit, they are hatched in 114 days, when at 43° in 101 days, and when at 45° in 90 days. When the fish are first hatched the yolk of the egg is found adhering to the under side of the little fry; this is gradually absorbed, but does not wholly disappear until the expiration of about four weeks. During this time the fry are entirely supported or fed by this yolk, and feeling no hunger they make no effort to procure food. When first hatched they are about five-eighths of an inch long, of a pale peach blossom color, and by the time they are two months old, they have grown to about an inch and a quarter in length. During this period their growth is very slow, at six months they are not more than three inches and a half long, and are easily recognized by the transverse dusky bars which mark their sides, and the small red dots about the lateral line.—They are now called Parr,* and retain this appearance and name until they have grown to the length of about seven inches. But here a change suddenly comes over them, they loose the dusky transverse markings and red spots, and take on a more Salmon-like appearance; the back and sides down to the lateral line assume a dusky greenish hue, the sides below the lateral line and the belly, and the ventral and anal fins a shining silvery white. The fish is now one year old, and is called a Salmon Smolt. As soon as this change

* The Parr appearance is believed to be common to the young of all the Salmonidæ at a certain age.

has taken place the young Salmon seems to hear the far off roar of the ocean and to have dreams of the pleasant feeding grounds away down in its fathomless deeps, for now he starts sea-ward, nor tarries long until he bathes for the first time in its salt waters. Here he remains about three months, feeding, as is now believed, principally on the eggs of the sea-urchin and the crab, which diet, with his sea-bathing, so well agrees with his constitution that though weighing not more than seven ounces when he left the river he will return at the end of three months weighing not less than four or five pounds. At this stage of his growth he is called a Grilse, not yet having attained that maturity which entitled him to the name of Salmon, and is, by an experienced observer, to be distinguished from a small Salmon, mainly by the smaller scales, longer and larger fins and more forked tail. The Grilse are however capable of propagating their kind, and for this purpose ascend the streams in July and August, returning again to the sea when their work is done, where they remain to the following spring, when they appear again in the rivers now having attained their maturity, as full grown Salmon, weighing ten or may be twenty pounds.

Economically, the Salmon is worthy of more than a passing consideration. There is no fish that ranks so high in general estimation, whether he be fresh, pickled, or smoked. For this reason he has been most mercilessly hunted, without regard to condition or age. It is all one whether he be "fair, fat, and forty," fresh from the sea; or lean, lank, and big-headed, just from the spawning beds; whether a full-grown Salmon at the maximum of size and value, or a Grilse not having attained more than half his growth, nay, even a Smolt or a Parr. In the United States they have long since left the waters of the Hudson and the Connecticut, and are yearly diminishing in the Kennebeck and Penobscot; and there is much reason to fear the same result in our own waters. Nor is it to the thoughtless destruction only of the fish that we are to attribute their rapid decrease. The erection of dams on the streams of such height that few or none can ascend to the spawning grounds, necessarily compels the Salmon to forsake them. It is a question well worthy the consideration of every political economist, of every one who has an interest in the full development of the resources of his country, (and who has not?) whether these abundant waters may not, without prejudice to their fullest use for navigation and manufactures, continue, in their fisheries, to be sources of wealth to the province. An examination of the exports of Canada will shew that in 1852 the value of the fish exported was £70,961; in 1853, £82,753; and in 1854, £84,730. The Beef and Pork taken together exported in 1854 amounted to only £33,544 14s. 6d., not worth half as much as the fish. I have not the means of ascertaining how large a portion of the fish were Salmon, but this I do know, that as the Salmon is the most valuable, fish for fish, the more we can develop our resources in Salmon, the more proportionably shall we add to the value of our fisheries. That with proper regulations, these resources can be more fully developed, is abundantly proved by the vast increase of Salmon in the Tay, Forth, Clyde, and other rivers, since the enforcement of protective laws.

In the Foyle the produce has been raised from forty-three tons to very nearly three hundred tons per annum. The movement of steamers and other vessels in no degree interferes with their migrations, nor do the din and clang of saw-mills, with light glaring the night through, frighten them from their journeyings. Nor need their movements be impeded by perpendicular dams of such height as to prevent them from running freely up and down the rivers. All difficulty is at once obviated by constructing an apron or slope on the lower side of every dam, extending from the top of the dam to the bottom of the river below, with a smooth even surface, sloping at an angle of forty-five degrees with the horizon, and located in the main channel of the stream. By enforcing the maintenance of such aprons to every dam, and restricting the capture of the fish to those seasons when alone they are fit for food and to that size which may be supposed to denote their maturity, a vast amount of wealth might be secured to Canada from the Salmon fishery. I have seen it stated, but have not the means of verifying it, that in the Provinces of Nova Scotia and New Brunswick the exports of Salmon alone, apart from the home consumption, which is enormous, amounts "to the annual value of several hundred thousands of pounds sterling." And with such noble rivers as we possess, what is to hinder us from deriving a like advantage? The Salmon demand of us no care for themselves, nor toil in raising and preparing food on which to fatten them; old ocean gives them free pasturage, and all they ask at our hands is the opportunity to propagate and grow.

Auxiliary to protective legislation is the diffusion among all classes of correct information respecting their Natural History and their economical value. The owner of a mill site needs to understand it is but just that, in erecting his dam, he should be obliged to build it in such a manner as not to make it a tax on the whole province by diminishing one of its sources of wealth. The fisherman should know that he can not be allowed to impoverish the fishery by taking half grown fish, merely that his immediate gains may be a little greater. And the dweller on the inland streams should learn to distinguish the spawning from the fresh run fish, and to know that the little Fry, the Smolt, and the Grilse, if suffered to remain in their native element, will in a few more months become the noble Salmon; and that the laws which forbid their capture are really made for his benefit.

Nothing has been said of the Salmon as a fish of game, how he has lured Sir Humphrey Davy from his Philosophy, Chitty from his Law, Wilson from his University; nor is there any need to one who has felt his arrowy rush and listened to the music of the swift running reel. A word might well be said illustrative of his habits under trying circumstances; how when the barbed iron is in his jaw, he leaps and runs and struggles to be free; how he tries to throw himself upon the lightened line, or to smash the tackle against a rock, but there is neither time nor space.

In Canada, the Salmon are found in the St. Lawrence and its tributaries, especially its large northern tributaries, and northward of the Gulf, in every stream that runs to the ocean. Some five and twenty years ago they were

abundant in Lake Ontario, running up the streams that emptied into it from the North, but the causes already enumerated have compelled them to seek more accessible spawning grounds. A few still return to their old haunts along the northern shore, but ere long some Canadian Cooper may write of "the last of the Salmon." The same is true of the streams from the South, so that in the Salmon River, in the State of New York, they have been re-established by the enforcement of judicious laws. The Salmon have never been known to enter the Niagara River, though frequently taken at its mouth; as if they knew its bold banks and deep current afforded no spawning bed, and that its cataract no Salmon could hope to leap.

In the streams of New Brunswick and Nova Scotia they still abound, though even there, the same reckless disregard of their habits, according to the testimony of Mr. Perley, points to their extermination at no very distant day.

ARTICLE XXIX.—*On the Pigeon, (Ectopistes Migratoria.)*

V. G. AUDUBON, Esq., Son of AUDUBON the great Ornithologist, and proprietor of his works, has, with the greatest kindness, given me permission to make extracts for this Magazine, not only from the works of his illustrious father, but also from his own. Several other eminent Naturalists and learned Societies have granted me similar favours, which will be acknowledged in the proper place.

E. B.

GENUS ECTOPISTES, (Linn.)

GENERIC CHARACTERS.—"Bill straight, of ordinary length, rather slender, broader than high at the base, with a tumid fleshy covering, compressed towards the end; head small, oblong; neck of moderate length; body rather slender; feet short; tarsus as short as the hind toe and claw, anteriorly scutellate; outer toe slightly shorter than inner; claws rather short, stout, arched, obtuse; plumage compact above; blended but firm beneath; wings long; first and second quills longest, and about equal; tail long, cuneate, pointed."—(AUDUBON'S SYNOPSIS, page 194.)

The name of this genus appears to have been derived from the Greek, (*Ektopisteos*), which signifies "frequently changing place or habitation."

ECTOPISTES MIGRATORIA, (Linn.)—The Blue Pigeon, Passenger Pigeon, or Wandering long tailed Dove.

SPECIFIC CHARACTERS.—*Male, upper parts, light greyish blue; throat, fore-neck, and breast, light brownish red; abdomen and lower tail coverts, white. Female, with tints much duller, the upper parts inclining to yellowish brown, the lower parts pale greyish, anteriorly tinged with yellowish brown. Male, 16¼, 25; Female, 15, 23. The specific name is from the Latin, (Migratorius,) Wandering.*

The family of birds to which our common blue Pigeon belongs, consists of a great many species distributed over all the tropical and temperate

climates of the world. Several varieties are described as inhabiting North America, but only one, so far as we have ascertained, visits Canada; and it is so generally known in the country, that it appears almost superfluous to give any description of it here. The principal peculiarity of the bird, however,—we mean its amazing gregariousness, is not often witnessed to its full extent in this Province, and we shall therefore give the interesting account furnished by Wilson in full, it is as follows:—

“This remarkable bird merits a distinguished place in the annals of our feathered tribes,—a claim to which I shall endeavor to do justice; and, though it would be impossible, in the bounds allotted to this account, to relate all I have seen and heard of this species, yet no circumstance shall be omitted with which I am acquainted, (however extraordinary some of these may appear,) that may tend to illustrate its history.

“The Wild Pigeon of the United States inhabits a wide and extensive region of North America, on this side of the great Stony Mountains, beyond which, to the westward, I have not heard of their being seen. According to Mr. Hutchins, they abound in the country round Hudson’s Bay, where they usually remain as late as December, feeding, when the ground is covered with snow, on the buds of juniper. They spread over the whole of Canada; were seen by Captain Lewis and his party near the Great Falls of the Missouri, upwards of 2500 miles from its mouth, reckoning the meanderings of the river; were also met with in the interior of Louisiana by Colonel Pike; and extend their range as far south as the Gulf of Mexico; occasionally visiting or breeding in almost every quarter of the United States.

“But the most remarkable characteristic of these birds is their associating together, both in their migrations, and also during the period of incubation, in such prodigious numbers, as almost to surpass belief; and which has no parallel among any other of the feathered tribes on the face of the earth, with which naturalists are acquainted.

NOTE.—The family is called COLUMBINÆ or COLUMBIDÆ, from the Latin, *Columba*, a dove. It contains a number of closely allied genera, the proper arrangement of which appears to have given much trouble to Ornithologists.—Audubon makes three genera in North America, *Columba*, *Sturnacus* & *Ectopistes*, and the species are:—

1. *Columba fasciata*, Band-tailed Dove.
2. *C. leucocephala*, White-headed Dove.
3. *C. Zenaida*, Zenaida Dove.
4. *C. montana*, Key-west Dove.
5. *C. passerina*, Passerine Dove—Ground Dove.
6. *Sturnacus cyanocephala*, Blue-headed Ground Dove.
7. *Ectopistes migratoria*, Passenger Pigeon.
8. *E. Carolinensis*, Carolina Long-tailed Dove.

These, with the exception of *E. migratoria*, are all confined to the Southern and Western portions of the continent. We understand that several others have been added since the publication of Audubon’s works.

In the British Isles there are four indigenous species:—

- 1st. The Ring Dove, Cushat, or Wood Pigeon, *Columba palumbus*.
- 2nd. The Rock or Wild Pigeon, *Columba livia*.
- 3rd. The Smaller Wood Pigeon, *Columba œnas*.
- 4th. The Turtle Dove, *Columba turtur*.

All the varieties of the domestic Pigeon, both of America and Europe, have the Rock Pigeon, *C. livia*, for their stock.

“These migrations appear to be undertaken rather in quest of food, than merely to avoid the cold of the climate; since we find them lingering in the northern regions, around Hudson’s Bay, so late as December; and, since their appearance is so casual and irregular, sometimes not visiting certain districts for several years in any considerable numbers, while at other times they are innumerable. I have witnessed these migrations in the Genesee country, often in Pennsylvania, and also in various parts of Virginia, with amazement; but all that I had then seen some of them were mere straggling parties, when compared with the congregated millions which I have since beheld in our western forests, in the states of Ohio, Kentucky, and the Indiana territory. These fertile and extensive regions abound with the nutritious beech nut, which constitutes the chief food of the Wild Pigeon. In seasons when these nuts are abundant, corresponding multitudes of Pigeons may be confidently expected. It sometimes happens that, having consumed the whole produce of the beech trees, in an extensive district, they discover another, at the distance perhaps of sixty or eighty miles, to which they regularly repair every morning, and return as regularly in the course of the day, or in the evening, to their place of general rendezvous, or, as it is usually called, the roosting place. These roosting places are always in the woods, and sometimes occupy a large extent of forest. When they have frequented one of these places for some time, the appearance it exhibits is surprising.—The ground is covered to the depth of several inches with their dung; all the tender grass and underwood destroyed; the surface strewed with large limbs of trees, broken down by the weight of the birds clustering one above another; and trees themselves, for thousands of acres, killed as completely as if girdled with an axe. The marks of this desolation remain for many years on the spot; and numerous places could be pointed out, where, for several years after, scarcely a single vegetable made its appearance.

“When these roosts are first discovered, the inhabitants, from considerable distances, visit them in the night with guns, clubs, long poles, pots of sulphur, and various other engines of destruction. In a few hours, they fill many sacks, and load their horses with them. By the Indians, a Pigeon roost, or breeding place, is considered an important source of national profit and dependence for that season; and all their active ingenuity is exercised on the occasion. The breeding place differs from the former in its greater extent. In the western countries above mentioned, these are generally in beech woods, and often extend in nearly a straight line across the country for a great way. Not far from Shelbyville, in the state of Kentucky, about five years ago, there was one of these breeding places, which stretched through the woods in nearly a north and south direction; was several miles in breadth, and was said to be upwards of forty miles in extent! In this tract, almost every tree was furnished with nests, wherever the branches could accommodate them. The Pigeons made their first appearance there about the 10th of April, and left it altogether, with their young, before the 25th of May.

“As soon as the young were fully grown, and before they left the nests, numerous parties of the inhabitants, from all parts of the adjacent country,

came with wagons, axes, beds, cooking utensils, many of them accompanied by the greater part of their families, and encamped for several days at this immense nursery. Several of them informed me, that the noise in the woods was so great as to terrify their horses, and that it was difficult for one person to hear another speak, without bawling in his ear. The ground was strewed with broken limbs of trees, eggs, and young Squab Pigeons, which had been precipitated from above, and on which herds of hogs were fattening. Hawks, Buzzards, and Eagles, were sailing about in great numbers, and seizing the Squabs from their nests at pleasure; while, from twenty feet upwards to the tops of the trees, the view through the woods presented a perpetual tumult of crowding and fluttering multitudes of Pigeons, their wings roaring like thunder, mingled with the frequent crash of falling timber; for now the axemen were at work, cutting down those trees that seemed to be most crowded with nests, and contrived to fell them in such a manner, that, in their descent, they might bring down several others; by which means the falling of one large tree sometimes produced two hundred Squabs, little inferior in size to the old ones, and almost one mass of fat. On some single trees, upwards of one hundred nests were found, each containing *one* young only; a circumstance, in the history of this bird, not generally known to naturalists. It was dangerous to walk under these flying and fluttering millions, from the frequent fall of large branches, broken down by the weight of the multitudes above, and which, in their descent, often destroyed numbers of the birds themselves; while the clothes of those engaged in traversing the woods were completely covered with the excrements of the Pigeons.

“These circumstances were related to me by many of the most respectable part of the community in that quarter, and were confirmed in part, by what I myself witnessed. I passed for several miles through this same breeding place, where every tree was spotted with nests, the remains of those above described. In many instances, I counted upwards of ninety nests on a single tree; but the Pigeons had abandoned this place for another, sixty or eighty miles off, towards Green River, where they were said at that time to be equally numerous. From the great numbers that were constantly passing over head to or from that quarter, I had no doubt of the truth of this statement. The mast had been chiefly consumed in Kentucky, and the Pigeons, every morning, a little before sunrise, set out for the Indiana territory, the nearest part of which was about sixty miles distant. Many of these returned before ten o'clock, and the great body generally appeared, on their return, a little after noon.

“I had left the public road to visit the remains of the breeding place near Shelbyville, and was traversing the woods with my gun, on my way to Frankfort, when, about one o'clock, the Pigeons, which I had observed flying the greater part of the morning northerly, began to return, in such immense numbers as I never before had witnessed. Coming to an opening, by the side of a creek called the Benson, where I had a more uninterrupted view, I was astonished at their appearance. They were flying, with great steadiness and rapidity, at a height beyond gunshot, in several strata deep,

and so close together, that, could shot have reached them, one discharge could not have failed of bringing down several individuals. From right to left, as far as the eye could reach, the breadth of this vast procession extended, seeming every where equally crowded. Curious to determine how long this appearance would continue, I took out my watch to note the time, and sat down to observe them. It was then half-past one. I sat for more than an hour, but instead of a diminution of this prodigious procession, it seemed rather to increase both in numbers and rapidity; and, anxious to reach Frankfort before night, I rose and went on. About four o'clock in the afternoon I crossed the Kentucky River, at the town of Frankfort, at which time the living torrent above my head seemed as numerous and as extensive as ever. Long after this I observed them, in large bodies that continued to pass for six or eight minutes, and these again were followed by other detached bodies, all moving in the same south-east direction, till after six in the evening. The great breadth of front which this mighty multitude preserved would seem to intimate a corresponding breadth of their breeding place, which, by several gentlemen, who had lately passed through part of it, was stated to me at several miles. It was said to be in Green county, and that the young began to fly about the middle of March. On the 17th of April, forty-nine miles beyond Danville, and not far from Green River, I crossed this same breeding place, where the nests for more than three miles, spotted every tree: the leaves not being yet out, I had a fair prospect of them, and was really astonished at their numbers. A few bodies of Pigeons lingered yet in different parts of the woods, the roaring of whose wings was heard in various quarters around me.

"All accounts agree in stating, that each nest contains only one young Squab. These are so extremely fat, that the Indians, and many of the whites, are accustomed to melt down the fat for domestic purposes, as a substitute for butter and lard. At the time they leave the nest, they are nearly as heavy as the old ones; but become much leaner after they are turned out to shift for themselves. *

"It is universally asserted, in the western countries, that the Pigeons, though they have only one young at a time, breed thrice, and sometimes four times, in the season: the circumstances already mentioned render this highly probable. It is also worthy of observation, that this takes place during that period when acorns, beech nuts, &c. are scattered about in the greatest abundance, and mellowed by the frost. But they are not confined to these alone,—buckwheat, hempseed, Indian corn, holly-berries, hack-berries, huckle-berries, and many others, furnish them with abundance at almost all seasons. The acorns of the live oak are also eagerly sought after by these birds, and rice has been frequently found in individuals killed many hundred miles to the northward of the nearest rice plantation. The vast quantity of mast which these multitudes consume is a serious loss to the bears, pigs,

* Wilson was mistaken in supposing that the Pigeon rears but one at a time. The eggs are two, and each brood consists generally of a male and female. The female sits 15 days, and the young leave the nest in 8 days after they are hatched. There are three or four broods in a year, between May and September.

squirrels, and other dependents on the fruits of the forest. I have taken, from the crop of a single Wild Pigeon, a good handful of the kernels of beech nuts, intermixed with acorns and chestnuts. To form a rough estimate of the daily consumption of one of these immense flocks, let us first attempt to calculate the numbers of that above mentioned, as seen in passing between Frankfort and the Indiana territory : If we suppose this column to have been one mile in breadth, (and I believe it to have been much more,) and that it moved at the rate of one mile in a minute, four hours, the time it continued passing, would make its whole length two hundred and forty miles. Again, supposing that each square yard of this moving body comprehended three Pigeons, the square yard in the whole space, multiplied by three, would give two thousand two hundred and thirty millions, two hundred and seventy-two thousand Pigeons !—an almost inconceivable multitude, and yet probably far below the actual amount. Computing each of these to consume half a pint of mast daily, the whole quantity at this rate would equal seventeen millions four hundred and twenty-four thousand bushels per day ! Heaven has wisely and graciously given to these birds rapidity of flight and a disposition to range over vast uncultivated tracts of the earth, otherwise they must have perished in the districts where they resided, or devoured up the whole productions of agriculture, as well as those of the forests.

“ A few observations on the mode of flight of these birds must not be omitted : the appearance of large detached bodies of them in the air, and the various evolutions they display, are strikingly picturesque and interesting.— In descending the Ohio by myself, in the month of February, I often rested on my oars to contemplate their aerial manœuvres. A column, eight or ten miles in length, would appear from Kentucky, high in air, steering across to Indiana. The leaders of this great body would sometimes gradually vary their course, until it formed a large bend, of more than a mile in diameter, those behind tracing the exact route of their predecessors. This would continue sometimes long after both extremities were beyond the reach of sight ; so that the whole, with its glittery undulations, marked a space on the face of the heavens resembling the windings of a vast and majestic river. When this bend became very great, the birds, as if sensible of the unnecessary circuitous course they were taking, suddenly changed their direction, so that what was in column before became an immense front, straightening all its indentures; until it swept the heavens in one vast and infinitely extended line. Other lesser bodies also united with each other as they happened to approach, with such ease and elegance of evolution, forming new figures, and varying these as they united or separated, that I never was tired of contemplating them. Sometimes a Hawk would make a sweep on a particular part of the column, from a great height, when, almost as quick as lightning, that part shot downwards out of the common track ; but, soon rising again, continued advancing at the same height as before. This inflection was continued by those behind, who, on arriving at this point, dived down, almost perpendicularly, to a great depth, and rising, followed the exact path of those that went before. As these vast bodies passed over the river near me, the

surface of the water, which was before smooth as glass, appeared marked with innumerable dimples, occasioned by the dropping of their dung, resembling the commencement of a shower of large drops of rain or hail.

"Happening to go ashore, one charming afternoon, to purchase some milk at a house that stood near the river, and while talking with the people within doors, I was suddenly struck with astonishment at a loud rushing roar, succeeded by instant darkness, which, on the first moment, I took for a tornado, about to overwhelm the house and every thing around in destruction. The people, observing my surprise, coolly said, "It is only the Pigeons;" and, on running out, I beheld a flock, thirty or forty yards in width, sweeping along very low, between the house and the mountain, or height, that formed the second bank of the river. These continued passing for more than a quarter of an hour, and at length varied their bearing so as to pass over the mountain, behind which they disappeared before the rear came up.

"In the Atlantic States, though they never appear in such unparalleled multitudes, they are sometimes very numerous; and great havoc is then made amongst them with the gun, and clap net, and various other implements of destruction. As soon as it is ascertained in a town that the Pigeons are flying numerously in the neighborhood, the gunners rise *en masse*; the clap nets are spread out on suitable situations, commonly on an open height in an old buckwheat field; four or five live Pigeons, with their eyelids sewed up, are fastened on a movable stick—a small hut of branches is fitted up for the fowler, at the distance of forty or fifty yards—by the pulling of a string, the stick on which the Pigeons rest, is alternately elevated and depressed, which produces a fluttering of their wings similar to that of birds just alighting; this being perceived by the passing flocks, they descend with great rapidity, and, finding corn, buckwheat, &c., strewed about, begin to feed, and are instantly, by the pulling of a cord, covered by the net. In this manner, ten, twenty, and even thirty dozen, have been caught at one sweep. Meantime, the air is darkened with large bodies of them, moving in various directions; the woods also swarm with them in search of acorns; and the thundering of musketry is perpetual on all sides, from morning to night.—Wagon loads of them are poured into market, where they sell from fifty to twenty-five, and even twelve cents per dozen; and Pigeons become the order of the day at dinner, breakfast, and supper, until the very name becomes sickening. When they have been kept alive, and fed for some time on corn and buckwheat, their flesh acquires great superiority; but, in their common state, they are dry and blackish, and far inferior to the full grown young ones, or Squabs.

"The nest of the Wild Pigeon is formed of a few dry slender twigs, carelessly put together, and with so little concavity, that the young one, when half grown, can easily be seen from below. The eggs are pure white. Great numbers of Hawks, and sometimes the Bald Eagle himself, hover about those breeding places, and seize the old or the young from the nest, amidst the rising multitudes, and with the most daring effrontery. The young, when beginning to fly, confine themselves to the under part of the

tall woods, where there is no brush, and where nuts and acorns are abundant, searching among the leaves for mast, and appear like a prodigious torrent rolling along through the woods, every one striving to be in the front.— Vast numbers of them are shot while in this situation. A person told me, that he once rode furiously into one of these rolling multitudes, and picked up thirteen Pigeons, which had been trampled to death by his horse's feet.— In a few minutes they will beat the whole nuts from a tree with their wings, while all is a scramble, both above and below, for the same. They have the same cooing notes common to domestic Pigeons, but much less of their gesticulations. In some flocks you will find nothing but young ones, which are easily distinguishable by their motley dress. In others, they will be mostly females; and again, great multitudes of males, with few or no females. I cannot account for this in any other way than that, during the time of incubation, the males are exclusively engaged in procuring food, both for themselves and their mates; and the young, being unable yet to undertake these extensive excursions, associate together accordingly. But, even in winter, I know of several species of birds who separate in this manner, particularly the Red-winged Starling, among whom thousands of old males may be found, with few or no young or females along with them.

“ Stragglers from these immense armies settle in almost every part of the country, particularly among the beech woods, and in the pine and hemlock woods of the eastern and northern parts of the continent. Mr. Pennant informs us, that they breed near Moose Fort, at Hudson's Bay, in N. lat. 51°, and I myself have seen the remains of a large breeding place as far south as the country of the Choctaws, in lat. 32°. In the former of these places they are said to remain until December; from which circumstance, it is evident that they are not regular in their migrations, like many other species, but rove about, as scarcity of food urges them. Every spring, however, as well as fall, more or less of them are seen in the neighborhood of Philadelphia; but it is only once in several years that they appear in such formidable bodies; and this commonly when the snows are heavy to the north, the winter here more than usually mild, and acorns, &c., abundant.

“ The Passenger Pigeon is sixteen inches long, and twenty-four inches in extent; bill, black; nostril, covered by a high rounding protuberance; eye, brilliant fiery orange; orbit or space surrounding it, purplish flesh-colored skin; head, upper part of the neck, and chin, a fine slate blue, lightest on the chin; throat, breast, and sides, as far as the thighs, a reddish hazel; lower part of the neck, and sides of the same, resplendent changeable gold, green, and purplish crimson, the latter most predominant; the ground color, slate; the plumage of this part is of a peculiar structure, ragged at the ends; belly and vent, white; lower part of the breast, fading into a pale vinaceous red; thighs, the same; legs and feet, lake, seamed with white; back, rump, and tail-coverts, dark slate, spotted on the shoulders with a few scattered marks of black; the scapulars tinged with brown; greater coverts, light slate; primaries and secondaries, dull black, the former tipped and edged with brownish white; tail, long, and greatly cuneiform, all the feathers

tapering towards the point, the two middle ones plain deep black, the other five, on each side, hoary white, lightest near the tips, deepening into bluish near the bases, where each is crossed on the inner vane with a broad spot of black, and nearer the root with another of ferruginous; primaries, edged with white; bastard wing, black.

“The female is about half an inch shorter, and an inch less in extent; breast, cinereous brown; upper part of the neck, inclining to ash; the spot of changeable gold, green, and carmine, much less, and not so brilliant; tail-coverts, brownish slate; naked orbits, slate colored; in all other respects like the male in color, but less vivid, and more tinged with brown; the eye not so brilliant an orange. In both, the tail has only twelve feathers.”

ARTICLE XXX.—*On the Species of Woodpeckers observed in the vicinity of the City of Ottawa.*

GENUS PICUS, (Linn.)

GENERIC CHARACTERS.—Bill stout, straight, angular, and generally wedge-shaped towards the tip; nostrils elliptical or oblong, situated at the base of the bill, and concealed by bristly feathers; legs, short; toes, three or four; claws large, strong, much curved, compressed very acute; wings of moderate length, or long, with the first quill very small, the third, fourth, and fifth longest; tail of twelve feathers, the lateral very small, and the three middle pairs with the shafts strong and large; tongue long, slender, and barbed towards, and at the tip. Generic name Latin, *Picus*, a Woodpecker.

The whole structure of the Woodpecker is admirably adapted to his mode of life. The skull is large and strong, in order to withstand the repeated shocks it receives from the forcible blows the bird deals upon the trees in pursuit of his food. The legs are stout, and the claws strong, sharp, and formed for climbing perpendicular surfaces; the breast bone has a remarkably small keel, to admit of the body being laid close to the tree, and the middle tail feathers are exceedingly strong, in order that by being pressed hard upon the rough bark, they may serve as an additional support. The wings are formed for short flights, from tree to tree, and the tongue is of extraordinary length, forming a long flexible probe or feeler, which can be thrust far into the small holes of the worms and insects, upon which the Woodpeckers feed. The point is like a slender barbed spear, with the spines directed backwards, which when thrust into an unlucky worm is sure to draw him forth from his retreat. It is furnished with a peculiar muscular apparatus, by the aid of which it can be shot out with great rapidity, and as suddenly or gradually withdrawn; and it is further provided with glands which secrete a viscid substance, that glues to its surface, any small insect with which it comes in contact.

Some ornithologists divide the family into several genera, but Audubon states that the groups present characters so undecided that it is better to

consider all those of North America as of one genus. Those which we have observed in the valley of the Ottawa we shall describe in the present article, and it is probable that the species we have to notice are generally distributed over the British Provinces, being more numerous in some localities than in others.

PICUS ARCTICUS, (Swainson.)—THE ARCTIC THREE-TOED WOODPECKER.

SPECIFIC CHARACTERS.—*Three-toed, crown of the head yellow, rest of upper parts black, lower parts white; Female without yellow on the head, length $10\frac{1}{2}$, breadth 16. Inhabits North America from the State of New York to the Arctic regions.*

This bird was long considered to be identical with the three-toed Woodpecker of the northern countries of Europe, but is now classified as a distinct species. Although very abundant in the Hudson's Bay Territories, and extending its range as far south as the State of New York, yet it is not numerous in Canada. Those that we have seen were in the pine forests of the Ottawa, and it is said they seek their food principally among the insects that infest the decaying trees of the pine-tribe rather than among those of the hardwoods. The circumstance that the head-quarters of the species, or the region where they most abound, is situated in the north, where the spruce, the fir, and pine, are almost the only trees, appears to support this view. De Kay, in the Natural History of New York, says it is a rare species in that State, but that he saw numbers of them on one occasion in the mountainous forests of Herkimer and Hamilton counties in June.

The following description given by Audubon will apply to nearly all the specimens:—

“Three-toed, with the upper parts glossy bluish black, the lower white, the sides and lower wing coverts transversely barred with black; tufts of bristly feathers black; crown of the head saffron yellow; a white line from behind the eye; a band of the same from the base of the upper mandible to beneath the ear coverts, succeeded by a black band; inner webs of all the quills and outer webs of the primaries spotted with white, there being seven spots on the outer and five on the inner webs of the three longest; four middle tail-feathers black, the next with an oblique band of white, the rest black only at the base, except the outermost, of which nearly all the inner web is of that colour; Female without yellow on the head.”

Male $10\frac{1}{2}$, 16.

Its geographical range is stated by Audubon to be, from the northern parts of New York to the Fur countries, as well as along the eastern declivities of the Rocky Mountains. Rather common, partially migratory.

A specimen which we shot in the Township of Hull, near the City of Ottawa, on the 10th of May, 1856, measured $9\frac{1}{2}$ inches only in length.

PICUS ERYTHROCEPHALUS, (Linn.)—THE RED-HEADED WOODPECKER.

SPECIFIC CHARACTERS.—*Head and neck bright crimson, that colour descending on the foreneck, and margined with a semilunar band of black; back, wings, and tail, glossy bluish black; inner secondaries, rump, and lower parts, pure white; young, with the head and neck brownish grey, streaked with dusky, edged with grey; secondary quills, yellowish white, barred with black; lower parts, greyish white; the sides, streaked with dusky. Male, 9,17; Female, 8½. Audubon's Synopsis, page 184. The specific name is from the Greek, (Erythraios,) red; and (Kephale,) the head. Breeds from Texas to Nova Scotia, and throughout the British Provinces.*

The Red-headed Woodpecker—the most common and the most observed of all the tribe in North America, subsists partly upon insects and in part upon vegetable food. Wild cherries, apples, Indian corn, and various kinds of berries constitute a portion of his food while they are in their season, and in making his selections he is known to exercise the taste and judgement of a connoisseur. The Indian corn is taken in its rich succulent milky state; and in the orchard, if you wish to find the earliest and sweetest apples, you have only to approach those trees on or near which our red-headed friend may be seen loitering. “Though this bird (says Wilson,) occasionally regales himself upon fruit, yet his natural and most useful food is insects, particularly those numerous and destructive species that penetrate the bark and body of the tree to deposit their eggs and larvæ, the latter of which are well known to make immense havock. That insects are his natural food, is evident from his wedge-formed bill, the length, elasticity, and figure of his tongue, and the strength and position of his claws, as well as from his usual habits. In fact, insects form at least two-thirds of his subsistence, and his stomach is scarcely ever found without them. He searches for them with a dexterity and intelligence, I may safely say more than human; he perceives by the exterior appearance of the bark where they lurk below; when he is dubious, he rattles vehemently on the outside with his bill, and his acute ear distinguishes the terrified vermin shrinking within to their inmost retreats, where his pointed and barbed tongue soon reaches them. The masses of bugs, caterpillars, and other larvæ, which I have taken from the stomachs of these birds have often surprised me. These larvæ, it should be remembered, feed not only on the buds, leaves and blossoms, but also on the very vegetable life of the tree—the alburnum, or newly forming bark and wood; the consequence is, that the whole branches and whole trees decay under the silent ravages of these destructive vermin. Will any one say, that taking half a dozen or half a hundred apples from a tree is equally ruinous with cutting it down? or that the services of a useful animal should not be rewarded with a small portion of that which it has contributed to preserve? We are told in the benevolent language of the scriptures, not to muzzle the mouth of the ox that treadeth out the corn, and why should not the same

generous liberality be extended to this useful family of birds which forms so powerful a phalanx against the inroads of many millions of destructive vermin?"

The rich, varied and striking plumage, together with the familiar sounds and movements of this bird are among the most interesting adjuncts of the rural scenery of North America. No field is perfect without its lively family of Red-headed Woodpeckers. No traveller, with a taste for the natural, can visit the inland districts without bearing away with him a recollection of the red cap and conspicuous black and white jacket of *P. erythrocephalus*. This bird delights most in sunny fields, where there are a few trees standing, or in half cleared spots with numbers of those tall stumps in Canada, known by the elegant name of *Rampikes*. In such places, during the whole of the warmer portion of the year, you are sure to meet with numbers amusing themselves by pursuing or playing with each other. They do not seem to dread the proximity of human habitations, but on the contrary are often somewhat numerous in the immediate neighbourhood of towns and cities.— In the country they sometimes breed within two or three hundred yards of the farm house, when a tree suitable to their purpose can be found. "When alighted on a fence stake by the road or in a field, and one approaches them (says Audubon,) they generally move sideways out of sight, peeping now and then to discover your intention; and when you are quite close and opposite, lie still until you have passed, when they hop to the top of the stake, and rattle upon it with their bill as if to congratulate themselves on the success of their cunning. Should you approach within an arms length, which may frequently be done, the Woodpecker flies to the first stake or the second from you, bends his head to peep, and rattles again as if to provoke you to a continuance of what appears to him to be excellent sport. He alights upon the roof of the house, hops along it, beats the shingles, utters a cry, and dives into your garden to pick the finest strawberries he can discover." "No sooner have they satisfied their hunger, than small parties of them assemble on the tops and branches of decayed trees, from which they chase different insects that are passing through the air, launching after them for eight or ten yards, at times performing the most singular manoeuvres, and on securing their victim return to the tree, where immediately after a cry of exultation is uttered. They pursue each other on wing in a very amicable manner, in long beautifully curved sweeps, during which the remarkable variety of their plumage becomes conspicuous, and is highly pleasing to the eye. When passing from one tree to another, their flight resembles the motion of a great swing, and is performed by a single opening of the wings, descending at first, and rising towards the spot on which they are going to alight, with ease and in the most graceful manner."

The nest of the Red-headed Woodpecker is placed in a hole bored in a tree by the indefatigable bill of the bird, and is not lined with leaves, feathers, or other materials, but simply enlarged to the proper dimensions, and made smooth and comfortable. The female lays six eggs of pure white, and the young are hatched in the beginning of the summer. They leave Canada for

the Southern countries in the month of October, and return again in May. It is said that while upon their migrations they travel during the night and rest and feed during the day, resuming their journey again about sunset.

PICUS AURATUS, (Linn.)—THE GOLDEN-WINGED WOODPECKER OR HIGH-HOLDER.

SPECIFIC CHARACTERS.—*Upper parts greyish, and brownish spotted with black; lower parts whitish, and yellowish spotted with black; a large white spot on the rump; a crescent shaped patch of black on the breast. Length, 12½; width, 16.—Inhabits the United States and British Provinces. The specific name is from the Latin, (Auratus,) gilded, or of a golden colour.*

This very beautiful bird is common in the edges of the woods or in those fields which are not much frequented, and where there may be a quantity of old trees lying on the ground, or dead ones still standing. In such places there are generally numbers of ant-hills, to the eggs of which he is particularly partial. His food, however, varies with the season, and, as is the habit of the Red-headed Woodpecker, the young Indian corn, cherries, berries, and other fruit, are freely partaken of when they are ripe, or otherwise suitable to his palate. This bird feeds more on the ground and is more frequently seen perching upon the branches of trees than the other species of Woodpeckers. While boring the holes in the trees for their nests, the male and female work alternately, the one standing by and encouraging the other, and then taking its place. Wilson states that he has seen a hole made by a pair of these birds which penetrated, first five inches straight forward, and then downward more than twice that distance, *through a solid black oak*. The female lays six white eggs, and when the young are hatched they crawl out of the hole and take to the branches of the tree, where they are fed by the parents.

The Golden-wing is a very lively active bird, and may be readily distinguished by the half-moon shaped spot of black on the breast, or the large patch of white on the rump, most conspicuously seen when the bird is on the wing and rising from the ground. It is rather common in Canada. Wilson gives the following account of their habits in confinement:—

“In rambling through the woods one day, I happened to shoot one of these birds, and wounded him slightly in the wing. Finding him in full feather, seemingly but little hurt, I took him home, and put him into a large cage, made of willows, intending to keep him in my own room, that we might become better acquainted. As soon as he found himself enclosed on all sides, he lost no time in idle fluttering, but throwing himself against the bars of the cage, began instantly to demolish the willows, battering them with great vehemence, and uttering a loud, piteous kind of cackling, similar to that of a hen when she is alarmed and takes to wing. Poor Baron Trenck never labored with more eager diligence at the walls of his prison, than this

son of the forest in his exertions for liberty ; and he exercised his powerful bill with such force, digging into the sticks, seizing and shaking them so from side to side, that he soon opened for himself a passage ; and, though I repeatedly repaired the breach, and barricaded every opening, in the best manner I could, yet, on my return into the room, I always found him at large, climbing up the chairs, or running about the floor, where, from the dexterity of his motions, moving backward, forward, and sidewise, with the same facility, it became difficult to get hold of him again. Having placed him in a strong wire cage, he seemed to give up all hopes of making his escape, and soon became very tame ; fed on young ears of Indian corn ; refused apples, but ate the berries of the sour gum greedily, small winter grapes, and several other kinds of berries ; exercised himself frequently in climbing, or rather hopping perpendicularly along the sides of the cage ; and, as evening drew on, fixed himself in a high hanging, or perpendicular position, and slept with his head in his wing. As soon as dawn appeared, even before it was light enough to perceive him distinctly across the room, he descended to the bottom of the cage, and began his attack on the ears of Indian corn, rapping so loud, as to be heard from every room in the house. After this, he would sometimes resume his former position, and take another nap. He was beginning to become very amusing, and even sociable, when after a lapse of several weeks, he became drooping, and died, as I conceived, from the effects of his wound."

The following is a more full description of the plumage of this bird :—

"The Gold-winged Woodpecker has the back and wings above of a dark umber, transversely marked with equidistant streaks of black ; upper part of the head, an iron gray ; cheeks and parts surrounding the eyes, a fine cinnamon color ; from the lower mandible a strip of black, an inch in length, passes down each side of the throat, and a lunated spot, of a vivid blood red, covers the hind head, its two points reaching within half an inch of each eye ; the sides of the neck, below this, incline to a bluish gray ; throat and chin, a very light cinnamon or fawn color ; the breast is ornamented with a broad crescent of deep black ; the belly and vent, white, tinged with yellow, and scattered with innumerable round spots of black, every feather having a distinct central spot, those on the thighs and vent being heart-shaped and largest ; the lower or inner side of the wing and tail, shafts of all the larger feathers, and indeed of almost of every feather, are of a beautiful golden yellow ; that on the shafts of the primaries being very distinguishable, even when the wings are shut ; the rump is white, and remarkably prominent ; the tail-coverts white, and curiously serrated with black ; upper side of the tail, and the tip below, black, edged with light, loose filaments of a cream color, the two exterior feathers serrated with whitish ; shafts, black towards the tips, the two middle ones, nearly wholly so ; bill, an inch and a half long, of a dusky horn color, somewhat bent, ridged only on the top, tapering, but not to a point, that being a little wedge-formed ; legs and feet, light blue ; iris of the eye, hazel ; length, twelve inches ; extent, twenty. The female differs from the male chiefly in the greater obscurity of the fine colors, and in wanting the black mustaches on each side of the throat.

"Though this species, generally speaking, is migratory, yet they often remain with us in Pennsylvania during the whole winter. They also inhabit the continent of North America, from Hudson's Bay to Georgia; and have been found by voyagers on the north-west coast of America. They arrive at Hudson's Bay in April, and leave it in September. Mr. Hearne, however, informs us, that "the Gold-winged Woodpecker is almost the only species of Woodpecker that winters near Hudson's Bay." The natives there call it *Ou-thee-quan-nor-ou*, from the golden color of the shafts and lower side of the wings. It has numerous principal appellations in the different states of the Union, such as "High-hole," from the situation of its nest, and "Hittock," "Yucker," "Piut," "Flicker," by which last it is usually known in Pennsylvania. These names have probably originated from a fancied resemblance of its notes to the sound of the words; for one of its most common cries consists of two notes, or syllables, frequently repeated, which, by the help of the hearer's imagination, may easily be made to resemble any or all of them."

PICUS PILEATUS, (Linn.)

SPECIFIC CHARACTERS.—*General colour, dusky black; head with a crest of bright red; a portion of the wing white, but not visible except when flying; length, 18, breadth, 28. Inhabits North America to the Arctic regions. The specific name is from the Latin, (Pileatus,) wearing a cap or bonnet, in allusion probably to the scarlet crest or cap of the species.*

This is the largest species of Woodpecker to be seen in Canada, and is not very common. In February, 1852, we saw a flock of seven or eight of them in the unsurveyed lands lying between the Ottawa and Georgian Bay, and have shot several on the Bennechere River, in the county of Renfrew. We have also seen them among the pines on the rocky hills in the Township of Hull, near the City of Ottawa. The following is Wilson's description:—

"This American species is the second in size among his tribe, and may be styled the great northern chief of the Woodpeckers, though, in fact, his range extends over the whole of the United States, from the interior of Canada to the Gulf of Mexico. He is very numerous in the Genesee country, and in all the tracts of high-timbered forests, particularly in the neighborhood of our large rivers, where he is noted for making a loud and almost incessant cackling before wet weather, flying at such times in a restless, uneasy manner from tree to tree, making the woods echo to his outcry. In Pennsylvania and the Northern States, he is called the Black Woodcock; in the Southern States, the Logcock. Almost every old trunk in the forest where he resides bears the marks of his chisel. Wherever he perceives a tree beginning to decay, he examines it round and round with great skill and dexterity, strips off the bark in sheets of five or six feet in length, to get at the hidden cause of the disease, and labors with a gayety and activity really surprising. I have seen him separate the greatest part of the bark from a large, dead pine

tree, for twenty or thirty feet, in less than a quarter of an hour. Whether engaged in flying from tree to tree, in digging, climbing, or barking, he seems perpetually in a hurry. He is extremely hard to kill, clinging close to the tree even after he has received his mortal wound; nor yielding up his hold but with his expiring breath. If slightly wounded in the wing, and dropped while flying, he instantly makes for the nearest tree, and strikes with great bitterness at the hand stretched out to seize him; and can rarely be reconciled to confinement. He is sometimes observed among the hills of Indian corn, and it is said by some that he frequently feeds on it. Complaints of this kind are, however, not general; many farmers doubting the fact, and conceiving that at these times he is in search of insects which lie concealed in the husk. I will not be positive that they never occasionally taste maize; yet I have opened and examined great numbers of these birds, killed in various parts of the United States, from Lake Ontario to the Alatomaha River, but never found a grain of Indian corn in their stomachs.

“The Pileated Woodpecker is not migratory, but braves the extremes of both the arctic and torrid regions. Neither is he gregarious, for it is rare to see more than one or two, or at the most three, in company. Formerly they were numerous in the neighbourhood of Philadelphia; but gradually, as the old timber fell, and the country became better cleared, they retreated to the forest. At present few of those birds are to be found within ten or fifteen miles of the city.

“Their nest is built, or rather the eggs are deposited, in the hole of a tree, dug out by themselves, no other materials being used but the soft chips of rotten wood. The female lays six large eggs, of a snowy whiteness; and, it is said, they generally raise two broods in the same season.

“This species is eighteen inches long, and twenty-eight in extent; the general color is a dusky brownish black; the head is ornamented with a conical cap of bright scarlet; two scarlet mustaches proceed from the lower mandible; the chin is white; the nostrils are covered with brownish white, hair-like feathers, and this stripe of white passes from thence down the side of the neck to the sides, spreading under the wings; the upper half of the wings is white, but concealed by the black coverts; the lower extremities of the wings are black, so that the white on the wing is not seen but when the bird is flying, at which time it is very prominent; the tail is tapering, the feathers being very convex above, and strong; the legs are of a leaden gray color, very short, scarcely half an inch; the toes very long; claws, strong and semicircular, and of a pale blue; the bill is fluted, sharply ridged, very broad at the base, bluish black above, below and at the point bluish white; the eye is of a bright golden color, the pupil black; the tongue, like those of its tribe, is worm-shaped, except near the tip, where for one-eighth of an inch it is horny, pointed, and beset with barbs.

“The female has the forehead, and nearly to the crown, of a light brown color, and the mustaches are dusky, instead of red. In both, a fine line of white separates the red crest from the dusky line that passes over the eye.”

S A P - S U C K E R S .

The next three species of Woodpeckers we shall notice have been called *Sap-suckers*, the name originating in the belief of many persons that the perforations made by them in the bark of fruit trees are for the purpose of enabling the bird to extract the sap. Ornithologists in defending their favourites, stoutly deny this charge, and on the contrary contend that those trees around which so many girdles are placed by these active little birds, are usually the most healthy in the orchard. Whether they draw out the sap or not, it appears to be quite true that they sometimes destroy a good deal of valuable property. The following remark which we have met with in a paper, entitled "*Notes on the Ornithology of Wisconsin*, by P. R. Hoy, M. D., of Racine Wisconsin, published in the Proceedings of the Academy of Natural Sciences, Philadelphia, is entitled to full confidence. Speaking of the yellow bellied Woodpecker (*Picus varius*,) he says:—"This Woodpecker visits the orchards during September and October, to feed upon the inner bark of the peach and cherry, girdling the stems so effectually as not unfrequently to kill the trees. I have watched them while thus engaged in my own garden, and have carefully examined under a microscope the contents of the stomachs of numerous specimens." * According to this statement, the boring operation of these Woodpeckers is at least some times injurious. It is probable, however, that the damage they occasion is more than repaid by the service they render it destroying the numerous insects that prey upon our fruit trees.

The three following species are somewhat common in Canada, being more or less numerous in every part of the country. From their general black and white colours they resemble each other, but are easily distinguished after a little attention.

PICUS VARIUS, (Linn,) YELLOW-BELLIED WOODPECKER.

SPECIFIC CHARACTERS.—*Male with the crown of the head and throat red, back black, variegated with white; lower parts yellow, a crescent of black on the fore part of the breast. Female the same, but without red on the throat; length, 8½; width, 15. Inhabits the United States and British Provinces, northward to the Saskatchewan. The specific name is Latin, (Varius,) changeable, or of divers colours or fashions.*

The Yellow-bellied Woodpecker, like most others of its tribe, bores a hole in a tree and lays its four or five white eggs in the cavity upon the bare wood. It generally, during the breeding season, retires to the more solitary woods, and is therefore not so numerous in the neighbourhood of the farms in the summer, as it is in autumn. The following is the more full description furnished by Wilson:—

"The Yellow-bellied Woodpecker is eight inches and a half long, and in extent fifteen inches; whole crown, a rich and deep scarlet, bordered with

* Proc. Acad. Nat. Sci., vol. 6, page 354.

black on each side, and behind forming a slight crest, which it frequently erects; from the nostrils, which are thickly covered with recumbent hairs, a narrow strip of white runs downward, curving round the breast; mixing with the yellowish white on the lower part of the breast; throat, the same deep scarlet as the crown, bordered with black, proceeding from the lower mandible on each side, and spreading into a broad, rounding patch on the breast; this black, in birds of the first and second year, is dusky grey, the feathers being only crossed with circular touches of black; a line of white, and below it another of black, proceed, the first from the upper part of the eye, the other from the posterior half of the eye, and both lose themselves on the neck and back; back, dusky yellow, sprinkled and elegantly waved with black; wings, black, with a large, oblong spot of white; the primaries, tipped and spotted with white; the three secondaries next the body are also variegated with white; rump, white, bordered with black; belly, yellow; sides under the wings, more dusky yellow, marked with long arrow-heads of black; legs and feet, greenish blue; tail, black, consisting of ten feathers, the two outward feathers on each side tipped with white, the next totally black, the fourth edged on its inner vane half way down with white, the middle one white on its interior vane, and spotted with black; tongue, flat, horny for half an inch at the tip, pointed, and armed along its sides with reflected barbs; the other extremities of the tongue pass up behind the skull in a groove, and end near the right nostril; in birds of the first and second year they reach only to the crown; bill, an inch long, channelled, wedge-formed at the tip, and of a dusky horn color. The female is marked nearly as the male, but wants the scarlet on the throat, which is whitish; she is also darker under the wings and on the sides of the breast. The young of the first season, of both sexes, in October, have the crown sprinkled with black and deep scarlet; the scarlet on the throat may be also observed in the young males. The principal food of these birds is insects; and they seem particularly fond of frequenting orchards, boring the trunks of the apple-trees in their eager search after them. On opening them, the liver appears very large, and of a dirty gamboge color; the stomach strongly muscular, and generally filled with fragments of beetles and gravel. In the morning, they are extremely active in the orchards, and rather shy than the rest of their associates.—Their cry is also different, but, though it is easily distinguishable in the woods, cannot be described by words."

PICUS VILLOSUS, (Linn.) HAIRY WOODPECKER.

SPECIFIC CHARACTERS.—*Upper parts, black and white; lower parts, white; hind head, scarlet. Female same as Male, but without red on the head; length, 9; breadth, 15. Inhabits United States and British Provinces. The specific name is Latin, (Villosus,) Hairy, in allusion to the hair-like feathers on the back.*

Wilson in describing this bird, says:—"This is another of our resident birds, and, like the former, a haunter of orchards, and borer of apple-trees,

an eager hunter of insects, their eggs and larvæ, in old stumps and old rails, in rotten branches and crevices of the bark ; having all the characters of the Woodpecker strongly marked. In the month of May he retires with his mate to the woods, and either seeks out a branch already hollow, or cuts out an opening himself. In the former case I have known his nest more than five feet distant from the mouth of the hole ; and in the latter he digs first horizontally, if in the body of the tree, six or eight inches, and then downward, obtusely, for twice that distance ; carrying up the chips with his bill, and scraping them out with his feet. They also not unfrequently choose the orchard for breeding in, and even an old stake of the fence, which they excavate for this purpose. The female lays five white eggs, and hatches in June. This species is more numerous than the last in Pennsylvania, and more domestic ; frequently approaching the farm-house and skirts of the town. In Philadelphia I have many times observed them examining old ragged trunks of the willow and poplar while people were passing immediately below. Their cry is strong, shrill, and tremulous ; they have also a single note, or *chuck*, which they often repeat, in an eager manner, as they hop about, and dig into the crevices of the tree. They inhabit the continent from Hudson's Bay to Carolina and Georgia.

"The Hairy Woodpecker is nine inches long, and fifteen in extent ; crown, black ; line over and under the eye, white ; the eye is placed in a black line, that widens as it descends to the back ; hind head, scarlet, sometimes intermixed with black ; nostrils, hid under remarkably thick, bushy, recumbent hairs, or bristles ; under the bill are certain long hairs thrown forward and upward ; bill, a bluish horn color, grooved, wedged at the end, straight, and about an inch and a quarter long ; touches of black, proceeding from the lower mandible, end in a broad black strip that joins the black on the shoulder ; back, black, divided by a broad, lateral strip of white, the feathers composing which are loose and unwebbed, resembling hairs,—whence its name ; rump and shoulders of the wing, black ; wings, black, tipped and spotted with white, three rows of spots being visible on the secondaries, and five on the primaries ; greater wing-coverts, also spotted with white ; tail, as in the others, cuneiform, consisting of ten strong-shafted and pointed feathers, the four middle ones black, the next partially white, the two exterior ones white, tinged at the tip with a brownish burnt color ; tail-coverts, black ; whole lower side, pure white ; legs, feet, and claws, light blue, the latter remarkably large and strong ; inside of the mouth, flesh colored ; tongue, pointed, beset with barbs, and capable of being protruded more than an inch and a half ; the os hyoides, in this species, passes on each side of the neck, ascends the skull, passes down towards the nostril, and is wound round the bone of the right eye, which projects considerably more than the left for its accommodation. The great mass of hairs, that cover the nostril, appears to be designed as a protection to the front of the head, when the bird is engaged in digging holes into the wood. The membrane which encloses the brain in this, as in all other species of Woodpeckers, is also of extraordinary strength, no doubt to prevent any bad effects from violent concussion while the bird is employed in digging for food. The

female wants the red on the hind head ; and the white below is tinged with brownish. The manner of flight of these birds has been already described under a former species, as consisting of alternate risings and sinkings. The Hairy Woodpeckers generally utter a loud, tremulous scream as they set off, and when they alight. They are hard to kill ; and, like the Red-headed Woodpecker, hang by the claws, even of a single foot, as long as a spark of life remains, before they drop.

“This species is common at Hudson’s Bay, and has lately been found in England. Dr. Latham examined a pair which were shot near Halifax, in Yorkshire ; and, on comparing the male with one brought from North America, could perceive no difference, but in a slight interruption of the red that marked the hind head of the former ; a circumstance which I have frequently observed in our own. The two females corresponded exactly.”

PICUS PUBESCENS, (Linn.) THE DOWNY WOODPECKER.

The Downy Woodpecker very much resembles the last described species, both in habit and marking, but is always much smaller. Its length is six inches and three quarters, and its extent twelve inches ; crown, black ; hind head, deep scarlet ; strip over the eye, white ; nostrils thickly covered with recumbent hairs, or small feathers, of a cream color ; these, as in the preceding species, are thick and bushy, as if designed to preserve the forehead from injury during the violent action of digging ; the back is black, and divided by a lateral strip of white, loose, downy, unwebbed feathers ; wings, black, spotted with white ; tail-coverts, rump, and four middle feathers of the tail, black ; the other three on each side, white, crossed with touches of black ; whole under parts, as well as the sides of the neck, white ; the latter marked with a streak of black, proceeding from the lower mandible, exactly as in the Hairy Woodpecker ; legs and feet, bluish green ; claws, light blue, tipped with black ; tongue formed like that of the preceding species, horny towards the tip, where, for one-eighth of an inch, it is barbed ; bill, of a bluish horn color, grooved, and wedge-formed, like most of the genus ; eye, dark hazel. The female wants the red on the hind head, having that part white ; and the breast and belly are of a dirty white.

The above seven species are all we have met with in the valley of the Ottawa, but there are several others mentioned by authors as occurring in Canada, which we have not seen. They are the following :—

PICUS CANADENSIS, (Gmel.) CANADIAN WOODPECKER.

Fourth toe considerably longer than third ; fourth quill longest, fifth longer than second ; bristly feathers over the nostrils dull yellow ; upper part of head and hind neck, glossy black ; over the eye a band of white, continuous with a transverse band of scarlet on the occiput, usually interrupted in the middle ; a black band from near the bill to the eye, continued behind it over the auriculars, and joining the back of the hind neck ; beneath this a white band from the angle of the mouth, curving backwards below the middle of the neck, so as to meet the other behind ; then a narrow band of

black from the base of the lower mandible and continuous with the black of the shoulders; upper part of the body, wings and tail, black, feathers along the middle of the back tipped with white; wing-coverts, the anterior excepted, and quills spotted with the same, there being on the four longest primaries seven spots on the outer, and five on the inner webs, on most of the secondaries five on each web, but on the outer quill only one patch on each web, and on the second three spots on the outer, and four on the inner web; four middle tail-feathers glossy black, the rest black towards the base, that colour gradually diminishing, so that the outermost is almost entirely white; lower parts white.

Extremely similar to *Picus villosus*, but always much larger.

Male, $10\frac{1}{2}$, $17\frac{3}{4}$.

From the northern parts of New York to the Fur Countries: Common. Migratory in winter to New York.

Audubon's Synopsis, page 177.

PICUS MARTINÆ, (Aud.) MARIA'S WOODPECKER.

Fourth toe slightly longer than third; fourth quill longest, third longer than fifth; tufts of bristly feathers over the nostrils, dull yellow; upper part of head, scarlet; forehead and occiput, black; a band of white over the eye; a black band from the bill to the eye, continued behind it over the auriculars, and joining the black of the hind neck; beneath this a band of white from the angle of the mouth, curving backwards below the middle of the neck, so as almost to meet its fellow behind; then a band of black from the base of the lower mandible, and continuous with the black of the shoulders; upper parts, black; feathers along the middle of the back tipped with white; wing-coverts and quills spotted with the same, there being on the four longest primaries seven spots on the outer, and four on the inner web, on most of the secondaries five on each web, but on the outer quill only one patch on each web, and on the second four spots on the outer, and three on the inner web; four middle tail-feathers glossy black, the next black on the inner web, and on the greater part of the outer toward the base, the rest black only at the base, the two outer being almost entirely white; lower parts white, tinged with grey, and a little red, the sides faintly mottled with dusky grey.

Male, $9\frac{2}{3}$; wing, $4\frac{1}{2}$.

A pair found at Toronto, Upper Canada.

Audubon's Synopsis, page 178.

PICUS HIRSUTUS, (Vieill.) BANDED THREE-TOED WOODPECKER.

Three-toed, with the upper parts deep glossy-black, the head with blue reflections, the back and wings tinged with brown; tufts over nostrils dull yellow; anterior part of head pale yellow, spotted with white; a band of white, with small dusky lines, from the angle of the mouth to the occiput; the back transversely banded with white; inner webs of the quills and outer webs of the primaries spotted with white, there being seven spots on the

outer, and five on the inner webs of the three longest quills; four middle tail-feathers black, the next white at the end, the rest white, unless at the base, but the outermost banded with black. Female with the head black, streaked with white.

Male, 9; wing, $4\frac{5}{12}$.

From Lake Superior to the Arctic Sea. Abundant. Resident.

Audubon's Synopsis, page 183.

PICUS CAROLINUS, (Linn.) RED-BELLIED WOODPECKER.

Male with the upper part of the head and hind neck bright carmine; the back and scapulars transversely banded with black and white; the rump and tail-coverts with the white predominating; primaries black, with a band of white; tail black, with the inner webs of the middle, and both webs of the outer barred with white; lower parts yellowish white, abdomen red; lower wing and tail-coverts white, spotted with dusky. Female similar, but with the top of the head ash-grey, and with less red on the abdomen.

Male, $7\frac{3}{4}$, $15\frac{3}{4}$. Female, 8, $14\frac{1}{2}$.

Breeds from Kentucky in the West, and from Maryland to Nova Scotia and Canada. Abundant in winter in all the Southern States, from Carolina to Texas, and especially in the Floridas.

Audubon's Synopsis, page 183.

ARTICLE XXXI.—A Chapter on Earthquakes.

On Thursday the 1st of May last, about twelve o'clock, noon, the City of Ottawa, and a portion of the surrounding country, experienced a shock which is believed to have been an earthquake of no great force, and confined in its effects to a limited area. In the house where we were engaged writing at the time, we first heard for two or three seconds a rolling sound like that made by a loaded waggon passing over a stony pavement, then felt a heavy jar which shook the building and threw down some wood loosely piled in the kitchen. The sound continued for a few seconds after the shock. In some of the other houses of the city the same shock was felt with more or less intensity, while in many it was not noticed. The *Aylmer Times* of Friday, published at the village of Aylmer, nine miles from Ottawa, says:—"At about half-past twelve yesterday, a smart shock of an earthquake was distinctly felt by the inhabitants of this place. Its duration was about ten seconds, sufficiently long and loud to create uneasy feelings in those who knew what it was. The atmosphere was hazy at the time, but perfectly calm thereby allowing the vibration in the houses and earth to be more clearly defined." In the country for several miles South and East of Ottawa, we have ascertained that the same phenomena were noticed at the same time. Some of the houses were even shaken with so much violence as to greatly alarm the inmates. In one, they supposed the chimney had fallen.

People in the fields did not notice anything unusual, except the sound. The atmosphere was perfectly undisturbed, and a gentleman who was walking across a field informed us that he felt no shaking of the earth, but heard what he supposed to have been two distant peals of thunder in quick succession, and which appeared to roll away towards the South. Papers published in the towns at the distance of twenty-five and fifty miles make no mention of this convulsion, and therefore while we are satisfied that it was an earthquake we think it was confined to a comparatively small extent of the earth's surface.

The cause of earthquakes is not known. There are many ingenious theories to account for the shaking of the earth, but none of them appear to be sufficient. Man is well and painfully acquainted with those terrific convulsions, but the cause which generates them appears to be situated deep down in the interior of the planet where its nature and the mode of its working can never be observed by him. We know that all motion is produced by the action of one or more masses of matter, whether animated or inanimated upon one or more other masses, and in general we can see not only the mass which moves, but also that which moves it. In an earthquake we can feel and sometimes see the ground beneath our feet in motion, but that which causes it to move we cannot see. It presents one of those problems, where the principal and most important facts are concealed from view. Were we possessed of the power of observing through the earth, no doubt the operations going on in the interior, would soon disclose the cause of many of the external unexplained phenomena, but as man does not possess that power, all reasoning upon the subject must, at least in the present state of our knowledge be, at best merely conjectural. During earthquakes the ground is violently shaken by quick vibrations, either upwards or sideways, or by a compound motion of such a character, that objects lying loose upon the surface are whirled round. The earth opens and swallows up cities—mountains are shaken and rent, and their fragments thrown down upon the plain, while the sea, as if frightened from its bed, rolls up over the land and washes away the ruins into its depths. At Lisbon, in 1755, a loud bellowing sound like thunder was heard underground, and in an instant afterwards the city was dashed to pieces, and sixty thousand persons killed. A great crowd of the survivors fled for safety to the quay, but that also gave way. It sank suddenly and totally disappeared, occasioning as it went down a tremendous whirlpool in the waters, which drew down a great number of boats and small vessels anchored near, full of people. Not one of the bodies, neither did any fragments of the wrecks ever rise again to the surface. The sea first retired, and then rolled back upon the shore to the height of fifty feet above its ordinary level, seizing upon and drowning hundreds of those who had escaped the earthquake and were flying about in despair, not knowing whither to go. The effects of this earthquake were felt over an area of the earth's surface four times greater than all Europe. It was noticed among the Alps, on the coast of Sweden, in the flat country of Germany, in the West Indies, in Africa, and it is also said slightly in Canada. A great wave, in some places sixty feet in height,

rolled along the coast of Spain, and at Tangier in Africa, rose and fell eighteen times upon the shore. At Funchal, in Maderia, it rose fifteen feet; and at Kinsale, in Ireland, a body of water suddenly entered the harbour and whirled round, and otherwise disturbed the vessels. The waters of Loch Lomond, in Scotland, without any apparent cause, rose several feet above their usual level. Ships at sea were violently shaken. On one, the concussion was so violent that the sailors were jerked suddenly upwards to the height of a foot and a half from the deck. This latter statement appears scarcely credible, and yet Humboldt mentions one still more extraordinary. He states that "in the overthrow of the town of Riobamba in 1797, the bodies of many of the inhabitants were found to have been hurled to Cullca, a hill several hundred feet in height, and on the opposite side of the river Lican." * There surely must be some exaggeration in this instance. How could the inhabitants have been hurled up into the air unless the town were also shot up along with them?

"In the year 1692 the Island of Jamaica was visited by a violent earthquake; the ground swelled and heaved like a rolling sea, and was traversed by numerous cracks, two or three hundred of which were often seen at a time opening and then closing rapidly again. Many people were swallowed up in these rents; some, the earth caught by the middle and squeezed to death, the heads of others only appeared above ground, and some were first engulfed and then cast up again with great quantities of water. Such was the devastation, that even at Port Royal, then the capital, where more houses are said to have been left standing than in the whole island beside, three quarters of the buildings, together with the ground they stood on sank down with their inhabitants entirely under water.

"The large store-houses on the harbour side subsided so as to be twenty-four, thirty-six, and forty-eight feet under water: yet many of them appear to have remained standing, for it is stated that after the earthquake, the mast heads of several ships wrecked in the harbour, together with the chimney tops of houses were seen projecting above the waves. A tract of land round the town, about a thousand acres in extent, sank down in less than one minute during the first shock, and the sea immediately rolled in. The Swan frigate which was repairing in the wharf was driven over the tops of many of the buildings and then thrown upon one of the roofs, through which it broke. The breadth of one of the streets is said to have been doubled by the earthquake." *

Hundreds of earthquakes have taken place, and have been recorded within the historic period, and during which all the principal phenomena were the same as in the two above mentioned. The surface of the earth in each was shaken over a greater or less extent and the sea agitated and heaped up into waves, rolled out upon the land. The phenomena of subterranean sounds do not always accompany these terrific convulsions. The great shock at

* See Humboldt's *Cosmos*; vol. 1, page 199, Behn's edition.

* Lyell's *Principles of Geology*, 8th edition; page 486.

Riobamba in 1797, which Humboldt describes as "one of the most fearful recorded in the physical history of our planet," was not accompanied by any noise whatever. In other instances, the explosion is heard after the shock, and often the sounds are heard without the shaking of the earth. "The nature of the noise," says Humboldt, varies also very much, being either rolling or rustling, or clanking like chains when moved, or like near thunder; or lastly, clear and ringing as if obsidian or some other vitrified masses were struck in subterranean cavities. As solid bodies are excellent conductors of sound, which is propagated in burnt clay, for instance, ten or twelve times quicker than in air, the subterranean noise may be heard at a great distance from the place where it originated." Thus in 1812 a tremendously loud noise resembling thunder, was heard over a space of 9,200 square miles in South America, unaccompanied by an earthquake, whilst at the distance of 632 miles to the northeast the volcano of St. Vincent in the lesser Antilles, poured forth a stream of lava. In 1742, on the great eruption of Cotopaxi, subterranean sounds resembling the discharges of cannon were heard at Honda, 436 miles distant. Although the precise nature of those causes which occasion earthquakes remains unknown, yet, by careful observation, many particulars concerning the direction, rate of travelling, and variations in the force of the vibrations appear to have been ascertained. If a stone be thrown into a pond of still water, the small waves produced will roll away in all directions in gradually increasing circles—becoming more feeble as they recede from the centre. The vibrations of an earthquake seem to originate from a shock given at one point and to travel away in the manner of the waves of water put in motion by the stone, but with much greater velocity. During the great earthquake at Lisbon, its waves spread across the earth's surface at the rate of twenty miles in a minute between the time the first shock was felt at Lisbon and its occurrence at other places. This velocity is greater than that of a cannon ball, and we may well imagine that the effects when passing under stone buildings would be of a violent character. Should the undulation be vertical, then the houses would be shaken upwards, but if horizontal, then their foundations would be jerked from beneath them. Were a number of light objects to be placed upon a table, and a smart blow with a hammer given to one end of the leaf, the vibrations would be lateral; but if the blow were given to the under side of the table, vertical. The articles upon the table would be shaken horizontally or vertically, according to the direction of the blow. All the shocks of earthquakes appear to be this experiment performed upon a large scale, the crust of the earth being the leaf of the table, and the cities representing the small objects upon it. The great and unanswered question is, whence does the original concussion which produces the tremblings proceed. Upon this point there are many theories. The one in which we believe is that all the effects of earthquakes are consequences of the sudden rending of the earth's interior crust. Beneath all Canada, and all the world beside, the crust of the earth, as all Geologists are aware, consists of a floor of solid rock. There is a little loose soil, a quantity small indeed, when compared to the bulk of the globe, strewn over

its surface, but not sufficient to cover the whole. The rocky floor is uncovered, and peeps out in thousands of places. The dwellings we have erected are built, some of them upon the beds of loose earth and others upon the rock. Any shock given to the earth's crust as great in proportion as a blow of a hammer to an ordinary sized table, would produce vibrations sufficient to overturn or partially wreck houses consisting merely of small stones piled one above the other, and if we return to our example of the table we shall see that a fissuring of the rock would have the same effect.—Many varieties of stone will crack upon the unequal application of heat; and were the leaf of a table composed of a single slab of stone, and were heat or any other force to be so applied as to cause it to be suddenly fissured, the resulting vibrations would be quite sufficient to set all small objects upon it in motion, causing some to fly in one direction and others in a different, while still others would be whirled round, according to circumstances. What would be the effect of one of those subterranean fissures running instantaneously for hundreds of miles through the solid rocky crust of the earth? We think that vibrations more or less violent would result. The effects produced by nature with the same forces and materials are similar, no matter whether the experiment be upon a small or large scale—upon a slab of stone a yard square, or an area in the crust of the earth of the size of a continent. When the tension exerted upon a mass of rock several miles in thickness is sufficient to rend it asunder; it would be indeed strange, were no vibrations to result. The fissuring of the rock at a great depth, even although those fissures might not extend up to the surface, would most probably be felt as a more or less violent jar by the inhabitants of those countries immediately above, while the sound might also appear like subterranean thunder, and be propagated at very considerable distances.

In all geologic ages those rendings of the earth's surface have been of frequent occurrence, and thousands of ancient cracks can be seen in every rocky region, to occasion any one of which would require a convulsion equal to a modern earthquake. Some of those fissures may be traced for a great many miles, and, although in general, the rock on each side still remains in its original position, and the parts in contact, yet in a large proportion of the instances, the fissure is several feet or yards in width, and filled up with new material, often veins of metallic ores. In many cases the country on one side has sunk down to a greater or less depth, while the other remains at its original level, thus producing what the miners call a "*Fault*," a word which has been adopted as a technical term in geology. There is no formation which is not traversed by these fractures, and they may be seen in all countries, thus proving that the whole surface of the earth has been subjected in all ages to convulsions caused by the action of forces pent up in its interior.

We have no reason to believe that the causes which have operated so powerfully in ancient times to fissure the earth's crust, have ceased to exist. We are as yet in total ignorance of their nature, and for aught we know all those old catastrophes may yet be shewn to have been occasioned by the

most ordinary operations of nature, and to be necessary to preserve that universal order which prevails throughout the planetary system. Although according to the strict rules of science, we are not permitted to reason, except upon facts actually observed, yet to a certain extent, we may indulge in conjectural speculations. These, although they often lead to error, yet sometimes guide to truth.

Granting that earthquakes may be caused by the occasional fissuring of rocks in the subterranean depths, it has next to be shewn by what force these fractures have been, and still are produced. Upon this point also we have no knowledge from direct observation. If the interior be subject to an intense heat sufficient to melt the hardest rocks, then it must be in a fluid or viscid state. The facts that as we descend, the temperature increases—that wherever there are openings through the surface, melted matter oozes out, and that great elevations and depressions of land which could not well occur, were the earth solid like a cannon ball, have been common in all ages, seem to demonstrate that; not only is the interior in a fluid state, but that the exterior crust is of no great thickness. Many mathematicians are of a contrary opinion, but notwithstanding all manner of calculations, the facts still remain. We do not believe that the myriads of short flexures to be seen in the Laurentian rocks of Canada could have been produced upon the surface of a planet, solid through to the centre, or even to the depth of twenty miles. And if such be the structure of the interior, then any fluctuations of the viscid mass within would cause movements of the exterior, elevating some portions—depressing others—straining the rocky covering, and now and then rending it asunder. The following passage from Sir John Herschel's writings, although not much regarded by Geologists, has always appeared to us to contain within it the explanation of nearly all the phenomena of earthquakes and volcanoes. While upon the subject of the constitution of the Sun, he says: "The Sun's rays are the ultimate sources of almost every motion which takes place on the surface of the earth. By its heat are produced all winds, and those disturbances in the electric equilibrium of the atmosphere which give rise to the phenomena of terrestrial magnetism. By their vivifying action vegetables are elaborated from inorganic matter, and become, in their turn, the support of animals and of man, and the sources of those great deposits of dynamical efficiency which are laid up for human use in our coal strata. By them the waters of the sea are made to circulate in vapour through the air, and irrigate the land, producing springs and rivers. By them are produced all disturbance of the chemical equilibrium of the elements of nature, which, by a series of compositions and decompositions, give rise to new products and originate a transfer of materials. Even the slow degradation of the solid constituents of the surface, in which its chief geological changes consist, and their diffusion among the waters of the ocean, are entirely due to the abrasion of the wind, rain and tides, which latter, however, are only in part the effect of solar influence and the alternate action of the seasons; and when we consider the immense transfer of matter so produced, the increase of pressure over large spaces in the bed of the

ocean, and diminution over corresponding portions of the land, we are not at a loss to perceive how the elastic power of subterranean fires, thus repressed on the one hand and relieved on the other, may break forth in points when the resistance is barely adequate to their retention, and thus bring the phenomena of even volcanic activity under the general law of solar influence."

The remarks in the above quotation concerning the "transfer of matter," appears to us to be of great importance in treating upon the causes of earthquakes. All the great formations of rock of a secondary origin consist of matter which does not occupy at present its original position upon the surface of the earth. The sedimentary rocks of North America are, in Pennsylvania, about four miles and a half in thickness, or in other words that part of the earth's surface is covered with a sheet of solid rock four and a half miles thick, the material of which has been transported from some other place. The effects of this enormous "transfer of matter" should have been the same as if the continent of North America were to be taken up bodily to the depth of four and a half miles and laid down upon the surface of Europe. If it be true, as many geologists suppose that the interior of the earth is in a semi-fluid state, it is probable that the addition of this enormous load of rock to the surface of Europe would cause the crust to sink down in that part of the world and force the subjacent fluid matter away under other regions, which would be elevated in consequence. The effects would be no doubt felt all over the world. New countries would rise up out of the sea, volcanoes would burst forth and all the present arrangements of land and water upon the face of the globe be changed. The consequences would be nearly the same, were the transfer to be made gradually instead of all at one time. Were one foot in thickness of rock only to be laid upon the surface of Europe in a thousand years, and were the process of accumulation to continue for a sufficiently great period of time, the burden would in the end become too great to be sustained, and a sinking of the surface must take place. The effects, instead of occurring all at once in one grand and general convulsion affecting the whole earth's surface, would be distributed piecemeal throughout many ages, and save, by a slight shudder now and then, indicating that some stratum of rock far beneath the surface had given way, would be imperceptible. Still, although the process might be slow yet it would be sufficient to occasion all the earthquakes, volcanoes, elevations and subsidences of land that have been noticed in historic times, or which can be shewn to have taken place in former ages.

The suggestion of Sir John Herschel, however, would only explain the phenomena of earthquakes, were it true that the interior of the earth is in a fluid state. Many facts, such as the increase of heat in deep mines; the rising and sinking of land, and the molten overflowings of volcanoes, seem to demonstrate that such is the condition of the interior; but, on the other hand, some of the most eminent mathematicians have carried through certain calculations of great complexity which appear to prove that either it is solid throughout, or that the crust is of such great thickness and strength that the transfer of very considerable masses of matter upon the surface would produce little effect. We shall probably in a future article give some account of these calculations.

ARTICLE XXXII.—On some of the Common Rocks of the British Provinces.

The student of nature in the country, who must depend upon reading and his own observation for the acquisition of a knowledge of the science of geology, should first learn to recognise those minerals and rocks which are the most abundant, and afterwards proceed to the study of those more rare. In the following article we shall point out a few of the former, and give some general accounts of their distribution compiled from such sources as we have at our command.

There are a few simple minerals which, by their various combinations, constitute the principal part of all the rocks visible upon the surface of the earth, and when a person has learned to know these at sight, he has made an important progress in practical geology. Thousands of square miles of the British Provinces are covered with masses of rock composed altogether of the five minerals, quartz, felspar, mica, hornblende, and carbonate of lime. The latter constitutes all the limestone of the country, while of the other four are composed nearly all those hard rocks, usually, but incorrectly called granite, which may be seen in the hilly regions on the northern frontier of the settlements, extending from the mouth of the St. Lawrence to the Georgian Bay. Granite is comparatively rare throughout the greater portion of Canada, although another rock which closely resembles it, and is composed of the same ingredients, is the most abundant of all, either in mountain masses or strewn in rounded boulders or angular blocks over the surface. This latter is *gneiss*, of which there are many varieties, all however composed principally of quartz, felspar, hornblende, and mica, combined in very variable proportions. Of this rock, we shall give a more particular account hereafter.

Of the minerals above mentioned, QUARTZ is one of the most common, and forms one of the principal ingredients in the structure of the hard crust which constitutes the exterior covering of the earth. It is generally of a white colour, and sufficiently hard to scratch glass or give fire with steel.—In fact, all the gun-flints once in use consist of a greyish or blackish variety of quartz. The fragments of white mineral often picked up in the fields and used for striking fire are quartz. Grains of quartz of greater or less size, and often veins of it, may be seen in nearly all the boulders near the southern margin of the Laurentine formations, while the great masses of rock which constitute the rugged hills of those portions of the Province where this extensive formation prevails, have often one fourth of their whole bulk composed of it.

Although the most common colour of quartz is milk white, yet it is often perfectly transparent or of various shades of white, yellow, red, or violet, and it is variously called *granular quartz*, *smoky quartz*, *fetid quartz*, *brown*

quartz, rose quartz, ferruginous quartz, violet quartz, or amethyst, according to its structure or appearance.

The most certain methods of deciding as to whether a particular specimen is quartz or not is to try it with glass and steel. If a fragment of mineral be white or transparent, and it will scratch glass and give sparks to steel, it may be pretty safely labelled as quartz.

Felspar somewhat resembles quartz in external appearance, being often white, and sometimes semi-transparent. It is however of an inferior degree of hardness and may be scratched with the point of a well tempered knife, while quartz is so hard that steel makes no impression upon it. It is of various colours, white, grey, yellow, blue, green, or red. It has generally a pearly lustre, and breaks up into rhomboidal fragments, a form never assumed by quartz in its fracture. Among the Laurentian rocks, and in the boulders derived from this formation specimens of felspar may be readily procured in this shape, and by frequently observing these, the eye will soon become familiar with the external appearance of the mineral with respect to its lustre, forms of cleavage, &c. When felspar and quartz of the same colour, however, are confusedly mixed together in small grains, they cannot be distinguished unless by an experienced eye without resort to other methods which we shall notice hereafter.

Mica is easily recognised. It is a mineral remarkable above all others for the facility with which it may be divided into thin leaves. It is often, though improperly called Isinglass. It is generally of various shades of yellow and brown. Very thin flakes are transparent. Large sheets of it are used by the Russians for windows in their ships, the advantage being, that while by reason of its transparency it serves the purpose of glass, yet, as it is exceedingly tenacious, it cannot be broken by the concussions resulting from the discharges of heavy artillery. It is also used for lanterns, and as heat does not destroy it, for stove doors. This mineral occurs in the gneiss and limestone of the Laurentian rocks in small scales or specks, or in crystals from one eighth to several inches in diameter, preserving however its lamellar character.

Hornblende is dark bottle-green or brownish green, or brown approaching to black, but when pulverized, of a greenish grey. Its lustre is vitreous or glassy, and it yields pretty easily to the knife. When in considerable masses it is tough, and is not easily broken like the brittle species. It is a very abundant mineral, being an essential ingredient of various species of rocks and is found in most countries.

The above four minerals by their combinations constitute a vast proportion of all the harder kinds of rock in Canada. Some idea of their abundances may be formed by taking a general view of the geographical extent of the Laurentian formation. This great system of rocks constitutes an irregular belt from one hundred to three or four hundred miles in width extending from Labrador to the country lying north of Lake Superior, a distance of more than a thousand miles. In its course it makes a deep bend towards the south and sends out a projection which crosses the St. Lawrence.

between Brockville and Kingston, and penetrates the State of New York to the neighbourhood of Lake Champlain. The whole of this vast tract of country consists almost altogether of stratified rocks composed of these four minerals, quartz, felspar, mica, and hornblende, with here and there a band of white crystalline limestone. Were all the forests and all the loose soil to be swept away from the formation, so that the actual solid crust of the globe could be seen, and were a spectator to be so placed above the earth that he could take a bird's-eye view of the whole region at one glance, the surface would appear to him to be constituted of multitudinous thin leaves of rock twisted and folded in every direction. These leaves would be the strata of gneiss, schist, or limestone, which form the great mass of the Laurentian system, and their twistings and foldings the effects of the ancient convulsions of nature by which they, although of the strongest rock, have been shrivelled up as a scroll.

The most abundant rock of the Laurentian system is what is called *Syenitic gneiss*, and in order to shew wherein this differs from granite, we shall give the following description of the origin and composition of these and a few others that will frequently be met with in Canada.

Granite.—This rock is composed of quartz, felspar, mica, and sometimes hornblende, and is of several varieties, such as—1st. *Granite*, properly so called, consisting of quartz, felspar, and mica. 2nd. *Graphic granite*, composed of quartz and felspar only, but so arranged as to produce an irregular laminar structure. When cut and polished in a direction across the plates of quartz and felspar, of which it consists, the surface of graphic granite appears to be covered with Hebrew letters inlaid and blended into the substance of the rock. Hence its name :

3rd. *Porphyritic granite*, which, in addition to the usual ingredients, contains distinct large crystals of felspar.

4th. *Syenitic granite*, composed of all four of the minerals, quartz, mica, and hornblende.

There are numerous other varieties, but the above are all we need notice for our present purpose, and they are all supposed to have been once in a fluid state and to have become consolidated by cooling. The true geological position of granite appears to be beneath every other species of rock, although it is often seen upon the surface, having been ejected, while fluid, thrust up through the others in solid masses, or uncovered by the removal of the once overlying formations. Sir Charles Lyell says, "all the various kinds of granite which constitute the plutonic family, are supposed to be of igneous origin, but to have been formed under great pressures at a considerable depth in the earth, or sometimes, perhaps under a certain weight of incumbent water. Like the lava of volcanoes, they have been melted, and afterwards cooled and crystallised, but with extreme slowness, and under conditions very different from those of bodies cooling in open air." A large proportion of the interior of the earth may therefore be granite, probably solid towards the surface where it supports the stratified rocks and fluid below. Pluto, a god of the ancients, was said to be the king of the lower regions, and hence

The granites are called Plutonic rocks, because they most abound and come up from his dominions to us upon the surface.

Granite is not stratified, but the rocks we are next to consider, although composed of the same ingredients, are disposed in regular layers from one inch to several feet in thickness, and it is these with which the student of Canadian geology will most frequently meet as they extend over the whole of the Laurentian country.

They consist of the different varieties of gneiss and schist.

1st. *Gneiss* is composed of quartz, felspar, and mica, stratified or arranged in regular beds.

2nd. *Syenitic gneiss* consists of the same materials, but with the addition of hornblende. This rock largely abounds in Canada, constituting the principal portion of the Laurentian formation. The principal difference between gneiss and granite is, that the latter is a rock of igneous origin, while the former is composed of materials deposited upon the bottom of the ancient oceans—and there consolidated. The Laurentian formation was therefore accumulated in a sea of still greater antiquity than that in which the Potsdam Sandstone was deposited. Boulders or beds of Gneiss may in general be recognised by their striped appearance. They often consist of alternate thin layers of quartz, felspar, and mica, and these minerals being of different colours the sides of the rock which present the edges of the respective laminae exhibit numerous stripes of white and black, or of lighter and darker colours. There is thus a sort of double stratification of gneiss. In the first place the formation is divided into strata, from one inch to three or four feet, and even twenty feet in thickness, totally separated from each other, and in the second place each bed consists of numerous laminae or thin leaves, from one eighth of an inch or less to several inches in thickness, blended together.

If the observer can see that a piece of rock is composed of quartz, felspar, and mica, and also that these ingredients are not uniformly mixed throughout, but arranged in alternate thin leaves, then he may be certain the specimen is gneiss in some one of its varieties.

Syenite is a name given to a variety of rock obtained from the quarries of Syene, in Egypt. It consists of quartz, felspar, and hornblende, but no mica. When hornblende is present in granite, the rock is called *Syenitic granite*, and when this mineral also occurs in gneiss, it is called *Syenitic gneiss*.

In the Laurentian formation the Syenitic gneiss is often of various shades of grey, and much resembles grey granite. Great masses may often be seen of a red colour, owing to its being largely composed of red felspar. Other varieties are almost black, from the great proportion of dark blackish green, hornblende, or mica they contain. These latter varieties also pass into schist, which is thus described by Sir Charles Lyell.

“*Hornblende schist* is usually black, and composed principally of hornblende, with a variable quantity of felspar, and sometimes grains of quartz. When the hornblende and felspar are nearly in equal quantities, and the rock

is not slaty, it corresponds in character with the greenstones of the trap family, and has been called primitive greenstone. It may be termed hornblende rock. Some of these hornblendic masses may really have been volcanic rocks which have since assumed a more crystalline or metamorphic texture.

"*Mica-schist*, or *Micaceous schist*, is next to gneiss, one of the most abundant rocks of the metamorphic series. It is slaty, essentially composed of mica and quartz, the mica sometimes appearing to constitute the whole mass. Beds of pure quartz also occur in this formation. In some districts garnets in regular twelve sided crystals form an integrant part of mica schist.

The great bulk of the Laurentian rocks consists of the above three species *Syenitic gneiss*, *Hornblende schist*, and *Mica schist*.

But in addition to these, the formation also includes many beds of white limestone, a rock identical in composition with the white marble, so much used for tombstones and other purposes in Canada and the neighbouring States. The white limestone is interstratified with the syenitic, gneiss, and other rocks. In some localities there may be seen hills of rock composed of beds of the limestone and syenitic gneiss, alternating with each other through a great thickness of strata. Sometimes there will be a single layer of limestone then a stratum of gneiss, then another of limestone, and so on for many yards in depth; but usually from twelve feet to several hundred feet in thickness of each deposit is found without any intermixture of the other.

The limestone is usually white, but often striped with grey bands. It is also at times somewhat reddish or flesh coloured, and frequently, as do many of the Laurentian rocks, contains crystals of other minerals. Of these, we shall, in some future article, give more full particulars.

The following wood cuts are intended to exhibit the manner in which the above mentioned rocks underlie the Silurian and higher formations in Canada.



Section from North to South across the River Ottawa, East of the City of Ottawa.

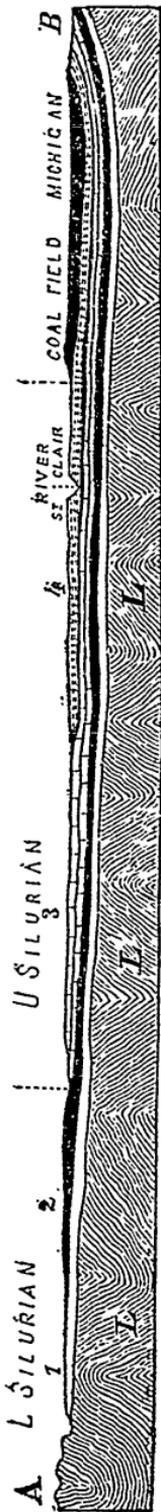
A geological section shews the structure of the earth's crust in any particular place where the section will apply to a certain depth. In the above section the structure of the country on the Ottawa river lying on both shores of the stream, and to the depth of nearly a mile, is intended to be shewn. The black mass at the figure 1 represents the ridge of low rocky hills usually seen near the north shore of the river. They consist in general of Syenitic gneiss interstratified with white crystalline limestone extending southwardly at a lower level under the Silurian rocks which repose upon them in following order. 1st. The Potsdam Sandstone represented by the dotted band lying above black. 2nd. The Calciferous Sandrock shewn by the loyest of the three bands, with the upright joints. 3rd. The Chazy,

Bird's-eye, and Black River Limestones, all included in the next band. 4th. The Trenton Limestone which constitutes the surface where the boulders are represented. 5th. The Utica Slate indicated by the black patches at figures 2 and 3. At the point 0, the Ottawa has worn out a deep channel down to the Potsdam Sandstone. Between the cavity of the stream and the hills, there is usually a bed of drifted materials, composed of sand, clay, or gravel, with boulders. Similar beds are generally seen on both shores, and in fact, spread over the whole country.

At the City of Ottawa the channel of the river is wholly excavated in the Trenton Limestone, which occupies both shores and constitutes the cliffs and islands at the Chaudiere Falls. At the Chatts, on the other hand, the Laurentine rocks cross the river from the north towards the south, and are seen on both banks of the stream to a point a short distance above the mouth of the Madawaska when the Trenton Limestone is again seen occupying the south shore at different points for some distance above Sand Point. From the Bonnechere to the upper extremity of the Calumet Island, the Laurentian rocks form the banks and obstructions of the river.

It appears probable that the range of hills that may be seen running along or near the north shores of the St. Lawrence, from its mouth to above Quebec, and thence still further west along the north side of the Ottawa is to be considered the shore of an ancient ocean. A person perched upon the summit of one of those hills at the point 1, in the above figure for instance, and looking south towards 2 and 3, may survey a vast tract of level country situated several hundred feet lower than the rocky pinnacle on which he may be standing. From such a position, he would be looking over the wide flat valley of an ancient ocean, whose waters long since withdrawn, have left as mementos of their former presence—the beds of Silurian rocks composed principally of the remains of the myriads of creatures that once enjoyed life in that sea. Were the water to be withdrawn from the Atlantic, those living upon the shore might descend into the deserted cavity, people the newly desiccated country, and cover it over with smiling fields and thriving towns. They might dig up from the soil the remains of the various marine animals, study their structure, and exhibit them in museums for the gratification of the curious. The Natural History of the Atlantic could then be ascertained long after the ocean, and all its tenants had ceased to exist. And, it is thus, that the greater number of the inhabitants of Canada are living in the bed of an ocean, of which the fossils accumulating in our museums are the organic remains.

The next figure is a section across Western Canada from the County of Victoria, passing westerly through the Counties of Ontario, York, Peel, Wellington, Waterloo, Oxford, Middlesex, Lambton, and into the State of Michigan. It is scarcely necessary to observe that the section is only a rough outline exhibiting the geological structure of the country in a very general way. At the point A in the County of Victoria, are seen the Laurentian rocks. They constitute the bottom in the direction indicated by the letters L L L westerly. Upon them repose 1 and 2 the Lower Silurian, 3 the Upper Silurian, and 4 the Devonian formations, which



Section across Western Canada from the County of Victoria into the State of Michigan.

latter cross the river St. Clair and support the coal field in Michigan. These formations here shew all their subdivisions, such as the Trenton Limestone, Utica Slates, Hudson River Groups, &c., mentioned in the first article of this journal. They are not indicated in the section, only the relative positions of the larger groups being shewn.

The section explains the meaning of the expression frequently used, "that Canada is too low for coal." In the Laurentian formation indicated by the letters L L L, or in rocks of equivalent age in other countries, no coal has ever been found. It will be seen in the section that these rocks, as well as the Silurian and Devonian, run under the true coal measures, and although they occupy the surface in some of the most elevated portions of the earth; upon the Himalaya Mountains for instance, yet geologically they are below the Carboniferous series of rocks.

The black band 2 in the section is intended to represent that portion of the Lower Silurian in which the dark coloured or black bituminous shales of the Utica Slate and Hudson River Groups prevail. These substances, on account of their being inflammable to a small extent, have often been mistaken for coal. They abound in the country lying east and north of Toronto, and it is not long since their fitness for the purposes of fuel was brought prominently before the public. The formation 2, however, as may be seen in the section, runs under the coal measures of Michigan, and is so well known that it may be safely affirmed that no coal will ever be found in it, although some of the beds, on account of their containing small quantities of bitumen, an inflammable substance, will, when placed upon a hot fire, give forth flame.

The rocks at Quebec in which coal has been stated to exist, are exactly the same as this formation No. 2, the Utica Slate and Hudson River group, and if a section similar to the above were to be carried south easterly to Nova Scotia, the same series of formations would be indicated. Where the section would cross New Brunswick, the coal would be found lying above the Quebec rocks in the same manner that the coal of Michigan is seen in the figure lying above the shale, which crops out in the country lying north of Toronto. In another article we shall pursue this subject further, and give some additional illustrations.

ARTICLE XXXIII.—On some of the Lower Silurian Fossils of Canada.

The following are some of the most common Fossils which occur in the Lower Silurian Rocks of Canada :—

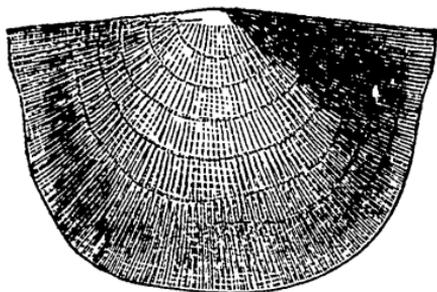


Fig. 1.—*Strophomena filitexta*, (Hall.)

The above figure exhibits the dorsal or convex valve of a very fine shell which occurs in the Trenton Limestone in great numbers at *Little Chaudiere Falls*, near the City of Ottawa,—at the 4th Chute of the Bonnechere, in the County of Renfrew, and at the lower end of the Allumette Island, opposite the Township of Westmeath, in the same county.

This species is of a semi-oval shape, and regularly convex or rounded from near the centre of the dorsal valve the highest point being a little nearer the hinge line than the centre. The ears are somewhat deflected or flattened. The ventral valve is regularly concave. The area is very large on the ventral valve, and the foramen nearly closed by a deltidium. The area is small on the dorsal valve. The surface is covered with fine rounded striae crowded close together, and crossed by fine concentric lines. In some specimens in our possession which appear to belong to this species, there are coarser striae at regular intervals, with six or seven of the smaller ones between.

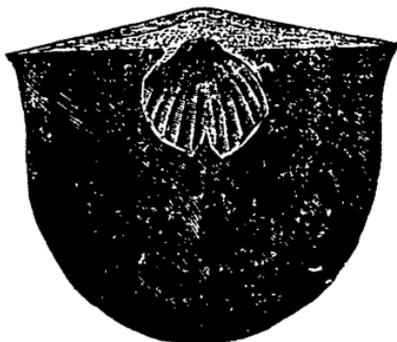


Fig. 2.—*Strophomena filitexta*, interior of ventral valve.

Fig. 2 shews the large "saucer-shaped" muscular cavity which forms the distinguishing character of the genus *Strophomena*. In the specimens

we have seen, the ridges in this cavity are not so conspicuous as they are in this figure, which is taken from Hall's Palæontology. The length of the hinge line or the straight side of this fossil is from an inch and a half to two inches, while the height from beak to base is from one inch to an inch and a half. The specific name appears to be from the Latin, *filum*, a thread, and *textum*, woven, in allusion to the woven appearance of the striæ on the shell. This character is not always clearly seen. This species occurs only in the Trenton Limestone, and is most numerous at the base of the formation—rarely in the upper part. For the technical terms used in this article, (see articles 18 and 19.)

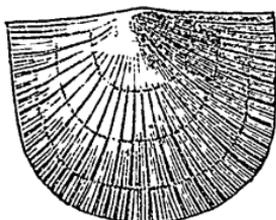


Fig. 3.



Fig. 4.

Figs. 3 and 4.—*Strophomena alternata*, (Conrad.)

This species is one of the most common and frequently quoted of the brachiopoda of the Lower Silurian rocks, and it is one of the most variable in form. It is found both in England and America, and we shall therefore give the descriptions of the palæontologists on both sides of the water, in the hope that from the two the species may be recognized with the more certainty.

Professor Hall says that this shell is "broadly semi-oval; length and breadth about as 12 to 15; hinge line, in perfect specimens, a little longer than the width of the shell, slightly reflected at the extremities, which sometimes become short acute ears; cardinal area narrow, the callosity of the ventral valve, nearly filling the triangular foramen of the dorsal valve; beak uniformly perforated with a minute circular opening; dorsal valve, depressed convex, sometimes more convex in the middle, suddenly deflected near the margin, and flattened towards the cardinal line; ventral valve concave, gradually or sometimes suddenly inflected towards the basal margin; surface marked by five rounded radiating striæ, which alternate at unequal intervals with coarser ones; striæ increasing in numbers towards the margin of the shell, crossed by fine elevated concentric lines and a few imbricating lines of growth.

"In this species the striæ are usually of two sizes, the coarser and more elevated ones having from four to six finer ones between them, the latter increase in number as they recede from the apex, and one of them in the centre of the fascicle becomes enlarged, and rises above the others. Some of the specimens figured are strongly marked individuals where these characters are very distinctly preserved; but there are many variations from the type

of the species, and some others where it is difficult to decide their true relations when we have not a series shewing their gradations."

Palæontology of New York, vol 1, page 102.

Professor McCoy in describing the English specimens, says:—"This species is longitudinally, semi-elliptical, or transversely subquadrate; receiving (ventral) valve gently convex along the middle, with a very short mesial sulcus close to the beak, gently deflected at the side margins when old; entering (dorsal) valve flat, or slightly concave, cardinal area very narrow, inclined back at about 120° , surface of both valves radiated with very fine linear thread-like striæ, separated by equally wide, flat, coarsely punctured spaces, when partially decorticated; striæ thicker and closer together, when the surface is preserved; striæ of two, more or less distinct sizes, usually three of the finer, between each pair of the larger; the middle subsequently increasing in size, and a new pair of small striæ being intercalated on each side; about eighteen striæ in the space of two lines, at six lines from the beak; interior of the valves marked with radiating external striæ, and with very numerous obtuse granules, nearly corresponding with the external punctures."

Sedgewick and McCoy's Palæozoic Rocks of Great Britain, page 233.

This species is found in the Trenton Limestone abundantly, and also in the Hudson River group. The specific name is from the Latin *Alternatus*, meaning alternated or changed by turns, in allusion to the different sizes of the striæ. It was originally placed in the genus *strophomena* by the American geologists. Afterwards called a *leptena*, both in Europe and America, but since the recent more extended observations upon the internal structure of these fossils, the genus *Strophomena*, as mentioned in a previous article, has been restored. The terms receiving and entering valves, made use of by Professor McCoy, are the equivalents of ventral and dorsal valves, as now more generally used. When the Palæontology of New York was written, these latter two terms were reversed in their meaning, which accounts for the brackets in the above quotations.

Leptena deltoidea is another fossil very like *S. Alternata* above figured. Its principal differences consist in its being usually more convex and pointed in front, like Fig. 4, than rounded below, like Fig. 3. There are, also, in most good specimens, a number of concentric wrinkles on the surface of the shell. We have not yet ascertained whether this fossil should be called a *Leptena* or a *Strophomena*. It occurs in the Trenton Limestone in many localities. The specific name is founded upon the form of the fossil, approaching the triangular shape of the Greek letter *delta*.

Orthis pectinella has the ventral valve flat towards the margin, and the dorsal valve convex, most prominent in the centre. The ventral valve has a low area, which is almost at right angles with the plane of the shell. The surface is marked by from 22 to 30 prominent, rounded, radiating ribs, with wide spaces crossed by small elevated concentric lines. This shell, when perfect, so that the ribs and concentric lines are well shewn, is a very pretty and neat fossil. There are several others, which are either varieties

of this or else closely related species. It occurs in the Trenton Limestone. The specific name is Latin, *Pectinella*, a little comb.



Fig. 5.



Fig. 6.



Fig. 7.



Fig. 8.



Fig. 9.



Fig. 10.

Fig. 5.—*Orthis pectinella*. Figs. 6, 7, 8, 9, and 10.—*Orthis Lynx*.

Orthis Lynx, (EICHWALD) commonly called *Delthyris* or *Spirifer lynx*, is a very common fossil in the Trenton limestone, at the City of Ottawa. Its form is exceedingly variable, but it is, notwithstanding this, easily recognized in all its shapes. The hinge line is straight, and often prolonged so as to form short, acute ears. Its outline is semi-elliptical, or sub-quadrate, and its surface bears a number of very strong radiating ribs. The ventral valve has a deep sinus in which there are three or four ridges, while the dorsal valve shews a corresponding mesial fold with four or five ribs. Figs 9 and 10 are views of the bottom of the fossil, shewing the large sinus in the margin. The beaks are about equally incurved, and the area is narrow, a little largest on the ventral valve. This fossil, usually, has both valves very much curved, and, in consequence, it sometimes approaches a globular shape. It has more the appearance of a *Spirifer* than of an *Orthis*, (see the figures of *Spirifer radiatus*, *S. Sulcatus*, and *S. Niagarensis*, Plate 2, in the 2nd number of this Journal, Figs, 3, 7, and 8) and it was until lately, most commonly known as *Spirifer lynx*. It is now, however, considered to be an *Orthis*. No species of *Spirifer* is described as existing in the Lower Silurian rocks of North America, in any of the books within our reach, and this shell, therefore, when met with in the Trenton limestone, is easily recognised, as it is the only fossil in the formation which presents the ears and other general external characters of that genus. The specific name was probably derived from the resemblance which some of the specimens bear to the head of a *Lynx*. The fossil is so variable in its form, that the figure of one specimen will not closely resemble others found in another locality, and therefore we have given a number from all of which the general idea of the species may be formed.

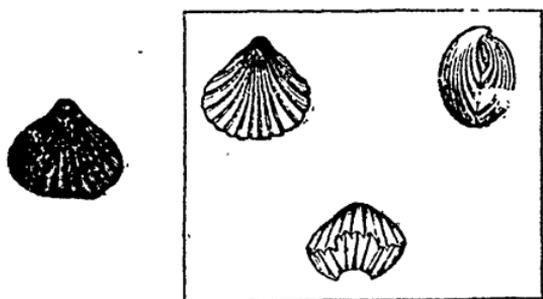


Fig. 11. Fig. 12. Fig. 13. Fig. 14.

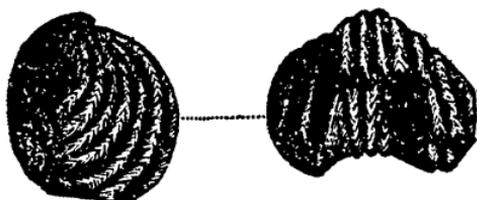


Fig. 15.

Fig. 16.

Figs. 11, 12, 13, 14, 15, 16.—Different specimens of *Atrypa increbescens*.

Atrypa v. increbescens may be considered the characteristic species of this genus for the Trenton Limestone, as it occurs abundantly in the rock in numerous and widely separated localities, shewing that it swarmed throughout the sea, which, during the period when this formation was deposited, covered all the middle portion of North America. This shell varies greatly in form, according to the age of the specimen. The young individuals are somewhat oval or triangular, and flat with the mesial fold and sinus, little developed. The old specimens are globular, and approaching the shape of figures 15 and 16. The dorsal or shorter valve has a deep sinus, with three or four ribs in the bottom, while the ventral valve has an elevated fold, with four or five. The number of radiating ribs is usually fifteen. The beak of the ventral valve is in the younger specimens acute and erect, slightly incurved at the point, but in the old shells closely hooked over the apex of the dorsal valve. The radiating ribs are never subdivided, but continuous from the base to beak, becoming more slender as they proceed upward.—They are crossed by imbricating zig-zag elevated lines, as seen in Figs. 15 and 16. This character, however, is only seen in perfectly preserved shells. Specimens are abundant, with the ribs well developed, but with little trace of those lines. This species occurs in the Trenton Limestone.

Atrypa plena is a fossil which occurs abundantly in certain layers of the chazy limestone, and very closely resembles *A. increbescens*. The number of plications or radiating ridges is, however, from 16 to 20, while *A. increbescens* has, at the most only about 15. The ridges are also sharper, and they are not crossed by the imbricating lines of the former species. There are four or five ridges in the bottom of the ventral sinus, and five or six on the mesial fold. We have seen some beds of limestone composed of

a dense mass of these fossils, packed closely together and well preserved.
Plenus, Latin, full, large or plentiful.



Fig. 17.



Fig. 18.



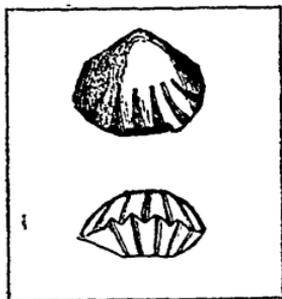
Fig. 19.



Fig. 20.



Fig. 21.



Figs. 22 and 23.

Figs. 17, 18, and 19.—*Atrypa plena*.

Figs. 20, 21, 22, and 23.—*Atrypa hemiplicata*.

Atrypa hemiplicata is easily recognised by its smoothness in the upper part, and by the broad folds below, which extend only half way to the beaks. This fossil is somewhat pentagonal, wider than long, and generally rather flat than globose. The sinus as well as the broad plications extend only half the length, and the surface is sometimes marked "by fine, concentric, filiform, subimbricating lines, which are more conspicuous towards the base of the shell, and beautifully undulated in crossing the plications." The beaks are very short, and about equally incurved. It is rather common in the Trenton limestone, but not so abundant as *A. increbescens*. The specific means simply *half-plicated*.

Professor Hall says:—"This peculiar and beautiful species is rarely found in western localities, but is nevertheless extensively distributed in New York. It is readily distinguished by its usually rotund figure, and short prominent plications in the lower half of the shell, while it is smooth above, or only marked by fine concentric lines. The sinus at the base usually occupies one fifth of the circumference of the shell, which, with the basal and cardinal slopes, give it a pentagonal appearance. In many specimens collected from the crystalline limestone, I have been able to observe only the plications on the mesial portion, while in the softer or shaly limestone, the lateral ones have all the distinctness of those presented in the figures."

ARTICLE XXXIV.—*Natural History of the Wolf, (Canis Lupus,) and its varieties.*

GENUS CANIS, (Linnæus.)

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

GENERIC CHARACTERS.—“The three first in the upper jaw, and the four in the lower, trenchant but small, and called also false molars. The great carnivorous tooth above bi-cuspid, with a small tubercle on the inner side, that below with the posterior lobe altogether tubercular, and two tuberculous teeth behind each of the great carnivorous teeth; muzzle, elongate; tongue soft; ears erect, (sometimes pendant in the domestic varieties); fore feet pentadactylous, (five-toed); hind feet tetradactylous, (four-toed); teats both inguinal and ventral.” *

CANIS LUPUS, (Linn.) THE AMERICAN WOLF.

There are several varieties of the American Wolf differing so much from each other as to lead naturalists to suspect that they are distinct species, and did not originate from the same primeval stock. They are all about the same size, and band together in the same pack; the Black, White, Grey, and Red being often seen in the same company. The Grey Wolf, the variety most common in Canada, bears a very striking resemblance to the European Wolf. There are, however, differences which appear to be permanent, and which occur in all the varieties of American Wolves; the body is generally more robust; the legs shorter and the muzzle thicker and more obtuse in the latter. Audubon and Bachman state that “they have examined a number of European Wolves, and although there were great differences between the various specimens, they were not able to satisfy themselves that the American Wolf is the largest, as supposed by other authors. They regard them as about the same size, and as exhibiting only varieties, not specific differences. The body of the American Grey Wolf is long and gaunt; muzzle elongated, and somewhat thicker than that of the Pyrenean Wolf; head thick; nose long; ears erect and conical; eyes oblique, as is the case in all true wolves—pupil of the eye circular; tail straight, and bushy. The animal does not curl it over the back like a dog.

“Behind the cheek there is a bunch of hairs, which look like a collar. The hairs are of two kinds, the longer coarse and rigid, the under fur soft and woolly; whiskers very few, and coarse and rigid; nails long, slightly arched. The long hairs, from their roots, for one third of their length, are yellowish white, then a broad band of brown follows, succeeded by yellowish brown, and the tips are black. The under fur is ashy brown. On the under surface the long hairs are white, nearly to the roots.

“The general appearance of the upper surface is dark brindled grey, with an indistinct dorsal line a little darker than the colour of the sides.”

* Audubon & Bachman's *Quadrupeds of America*, vol. 2, page 126.

The under parts are dull white.

Nostrils black ; from the nose towards the eyes, reddish yellow. The outer surface of the ears, and outsides of hind legs, from the hip to the knee joint, are also reddish yellow. The whiskers are black.

DIMENSIONS.

	Feet.	Inches.
Length from point of nose to root of tail.	4	0
Length of tail, (vertebræ).	1	1
Length of tail to end of hair.	1	5
Height of ear.	0	4
Breadth of ear.	0	3
From nose to end of skull.	0	11½
From the eye to point of nose.	0	5
Shoulder to longest nail.	2	4
Longest upper canine tooth.	0	1½
Length of the hair on the back, 3 to 4 inches." *		

The above are the dimensions and description of a Grey Wolf, and so far as form and dimensions are concerned, they apply nearly to the other varieties. The wolves of America are classified as follows :—

1. *Canis (lupus,) griseus.*—The Grey Wolf, characters as above.

2. *Canis (lupus,) ater.*—The Black American Wolf, size and shape of grey wolf, but black.

3. *Canis (lupus,) albus.*—The White American Wolf, size and shape of the grey wolf, fur over the whole body of a yellowish white colour, with a slight tinge of grey on the nose.

4. *Canis (lupus,) rufus.*—The Red Texan Wolf, shape of the common grey wolf, but color varied with red and black above, lighter beneath ; end of tail black. Most common in Texas.

5. *Canis latrans.*—The Barking or Prairie Wolf, intermediate in size between the grey wolf and the common fox ; greyish, varied with black, with a straight bushy tail. Inhabits the western prairies.

The last is considered, we believe, decidedly a distinct species, but the other four are thought, to be all only varieties of the same. The genus (*Canis*) is remarkable for the endless differences in size and form of the animals classified within it, as may be witnessed in the domestic species.—(*Canis familiaris*.) which affords permanent races of every size, from three inches in height and four inches long, to four feet in height and six feet long. Neither does this difference consist in size alone, but in the form and proportion of the parts. There is more difference in form between the head of a bull-dog and a grey-hound, than there is between that of the bull-dog and lion. Yet all the domesticated dogs are at present regarded by many good naturalists as descended from the same stock. The variety of characters among the wild dogs are also great in the same species, but not so great as among those subjected by man.

* Audubon & Bachman, vol. 2, page 280.

The following particulars concerning the habits of the Wolf have been kindly noted for us by A. Dickson, Esq., of Kingston, who at one period of his active life was as well known for his love of the chase, as he has since become distinguished for his enthusiasm in the cause of Geology and Natural History generally:—

“The Canadian Wolf is a cruel, savage, cowardly animal, with such a disposition that he will kill a whole flock of sheep merely for the sake of gratifying his thirst for blood, when one or two would have been sufficient for his wants. I have always found them the most cowardly of animals,—when caught in a trap, or wounded by a gun, or when cornered up so that they could not escape, I invariably killed them with a club or tomahawk, and I never met with any resistance. It is true I have seen them show some boldness if a number of them had run down a deer when I attempted to drive them away, yet I have always seen them give way if a shot were fired amongst them. They are frequently killed on the road when unable to get into the deep soft snow from weakness. They sometimes so gorge themselves upon a deer that they are helpless, and can be killed with an axe or club. The wolves are very destructive upon the deer, and hunt them singly or in packs, both in summer and winter. If water be near, the deer when hunted, makes for it, as he has a better chance of escape from being able to swim faster and with more ease than the wolf, as it generally loses some time before it strikes the deer track, where he again takes to the land, as he almost invariably swims either up or down the river instead of crossing direct; indeed, he will sometimes come on shore on the same side, thereby throwing the wolf off the track; and, if there happen to be weeds or brush about the bank, the deer will often sink himself so that nothing but part of his head will be above water. The wolf then has its chase for nothing, but in the winter season when the deer goes upon the ice the wolf makes a short chase of it, as the deer slips and falls down every bound he makes upon the glare ice. But if the deer take to a rapid, sufficiently deep to sweep the wolf off his feet, and not so deep but that the deer can stand or walk, the chances then are that a strong buck may kill the wolf by striking him with his fore hoofs. I have lost several good dogs in the same manner. In these cases the deer shows great tact in either striking his enemy, or leaping aside and allowing the wolf to be swept past by the current. In winter when there is not a crust sufficiently strong on the snow to carry the wolf, great numbers perish from hunger; if it were not for that, they would soon become so numerous that the country would be overcome by them.

“Wolves are often shot, but the most successful way of destroying them is by the trap or poison; since strychnine has been used, a great many have been destroyed in the settlements where they commit depredations. They have been known to kill weak horned cattle two years old, when not protected by older cattle. They have also been known to kill yearling colts.

“One day in travelling along a path, a fine Indian dog I had with me made a sudden dash to one side after some game, and I sat down to eat something, when all of a sudden my dog upset me, when I recovered my equilibrium

my first impulse was to punish the dog, which was still clinging to me in fear. I looked round and beheld a monstrous wolf, within a few feet of me. From these attitudes, I felt convinced the dog had started the wrong game and had caught a tartar, he soon retired, and upon examining the dog his hind parts were covered with saliva from the wolf's mouth. I immediately went on, as it commenced snowing, and followed his track for twelve miles before he left the path. The dog was a brave one, yet I could not keep him from my feet the whole of that distance; many dogs will attack a bear that cannot be got to look at a wolf, although well backed by numbers."

The following is from the English Cyclopædia :—

"Sir John Richardson, in the 'Fauna Boreali-Americana,' observes that the Common Wolves of the Old and New Worlds have been generally supposed to be the same species—the *Canis Lupus* of Linnæus. The American naturalists have indeed, he remarks, described some of the northern kinds of wolf as distinct; but it never seems to have been doubted that a wolf possessing all the characters of the European Wolf exists within the limits of the United States. He then goes on to point out that the wolf to which these characters have been ascribed seemed to be the Large Brown Wolf of Lewis and Clark; and, according to them, it inhabits not only the Atlantic countries, but also the borders of the Pacific and the mountains which approach the Columbia River, between the great falls and rapids, but is not found on the Missouri to the westward of the Platte. Richardson remarks that he had seen none of these Brown Wolves.

"In the 'New Description of Virginia,' (1640) wolves are mentioned among the beasts found there; and Lawson notices the Wolf of Carolina, and thus describes him :—"The Wolf of Carolina is the dog of the woods. The Indians had no other curs before the Christians came amongst them. They are made domestic. When wild, they are neither so large nor fierce as the European Wolf. They are not man-slayers, neither is any creature in Carolina unless wounded. They go in great droves in the night to hunt deer, which they do as well as the best pack of hounds; nay, one of these will hunt down a deer. They are often so poor that they can hardly run.—When they catch no prey they go to a swamp, and fill their belly full of mud; if afterwards they chance to get anything of flesh, they will disgorge the mud and eat the other. When they hunt in the night, and there are a great many together, they make the most hideous and frightful noise that ever was heard. The fur makes good muffs. The skin, dressed to a parchment, makes the best drum-heads, and if tanned makes the best sort of shoes for the summer countries."

"Catesby says :—"The wolves in America are like those of Europe in shape and colour, but are somewhat smaller. They are more timorous, and not so voracious as those of Europe. A drove of them will fly from a single man, yet in very severe weather there have been some instances to the contrary. Wolves were domestic with the Indians, who had no other dogs before those of Europe were introduced, since which the breed of wolves and

European dogs are mixed and become prolific. It is remarkable that the European dogs that have no mixture of wolfish blood have an antipathy to those that have, and worry them whenever they meet. The wolf-breed act only defensively, and, with his tail between his legs, endeavours to evade the other's fury. The wolves in Carolina are very numerous, and more destructive than any other animal. They go in droves by night, and hunt deer like hounds, with dismal yelling cries."

"Sir John Richardson gives a minute description of the *Canis Lupus occidentalis*, American Wolf, the Missouri Wolf of Lewis and Clark, and states that he does not mean to assert that the differences existing between it and its European congener are sufficiently permanent to constitute them, in the eye of the naturalist, distinct species. The same kind of differences, he observes may be traced between the foxes and native races of the domestic dog of the New World and those of the Old; the former possessing finer, denser, and longer fur, and broader feet, well calculated for running on the snow. These remarks were elicited by a comparison of living specimens of American and Pyrenean wolves; but he had not an opportunity of ascertaining whether the Lapland and Siberian wolves, inhabiting a similar climate with those of America, had similar peculiarities of form, or whether they differed in physiognomy from the wolf of the south of Europe. He therefore considered it unadvisable to designate the northern wolf of America by a distinct specific appellation, lest he should unnecessarily add to the list of synonyms. The word *occidentalis*, which is affixed to the Linnæan name of *Canis Lupus*, is, he tells us, to be considered as merely marking the geographical position of that peculiar race of Wolf.

"This animal is very common throughout the northern regions of America, but more or less abundant in different districts. "Their foot-marks," says Richardson, "may be seen by the side of every stream, and a traveller can rarely pass a night in these wilds without hearing them howling around him. They are very numerous on the sandy plains which, lying to the eastward of the Rocky Mountains, extend from the sources of the Peace and Saskatchewan rivers towards the Missouri. Their bands of them hang on the skirts of the buffalo (bison) herds, and prey upon the sick and straggling calves. They do not, under ordinary circumstances, venture to attack the full-grown animal; for the hunters informed me that they often see wolves walking through a herd of bulls without exciting the least alarm; and the marksmen, when they crawl towards a buffalo for the purpose of shooting it, occasionally wear a cap with two ears, in imitation of the head of a wolf, knowing from experience that they will be suffered to approach nearer in that guise. On the Barren-Grounds through which the Coppermine River flows I had more than once an opportunity of seeing a single wolf in close pursuit of a reindeer; and I witnessed a chase on Point Lake when covered with ice, which terminated in a fine buck reindeer being overtaken by a large white wolf, and disabled by a bite in the flank. An Indian, who was concealed on the borders of the lake, ran in and cut the deer's throat with his knife, the wolf at once relinquished his prey and sneaked off. In the

chase the poor deer urged its flight by great bounds, which for a time exceeded the speed of the wolf; but it stopped so frequently to gaze on its relentless enemy, that the latter, toiling on at a 'long gallop' with its tongue lolling out of its mouth, gradually came up. After each hasty look the poor deer redoubled its efforts to escape; but, either exhausted by fatigue or enervated by fear, it became, just before it was overtaken, scarcely able to keep its feet."

"The same author observes that the wolves destroy many foxes, which they easily run down if they perceive them on a plain at any distance from their hiding-places; and he relates that in January, 1827, a wolf was seen to catch an Arctic Fox within sight of Fort Franklin, and although immediately pursued by hunters on snow-shoes, it bore off its prey in its mouth without any apparent diminution of its speed. The same wolf, he adds, continued for some days to prowl in the vicinity of the fort, and even stole fish from a sledge which two dogs were accustomed to draw home from the nets without a driver. As this kind of depredation could not be allowed to go on, the wolf was waylaid and killed. It proved to be a female, which accounted for the sledge-dogs not having been molested. He further states that the buffalo-hunters would be unable to preserve the game they kill from the wolves if the latter were not as fearful as they are rapacious. The simple precaution of tying a handkerchief to a branch, or of blowing up a bladder and hanging it so as to wave with the wind, is sufficient to keep herds of wolves at a distance. At times, however, he says that they are impelled by hunger to be more venturous, and that they have been known to steal provisions from under a man's head in the night, and to come into a traveller's bivouac and carry off some of his dogs. "During our residence in Cumberland House in 1820," continues Sir John, "a wolf, which had been prowling round the fort, and was wounded by a musket-ball and driven off, returned after it became dark, whilst the blood was still flowing from its wound, and carried off a dog from amongst fifty others, that howled piteously, but had not courage to unite in an attack on their enemy. I was told of a poor Indian woman who was strangled by a wolf, while her husband, who saw the attack, was hastening to her assistance; but this was the only instance of their attacking human life that came to my knowledge. As the winter advances and the snow becomes deep, the wolves, being no longer able to hunt with success, suffer from hunger, and in severe seasons many die. In the spring of 1826 a large gray wolf was driven by hunger to prowl amongst the Indian huts which were erected in the immediate vicinity of Fort Franklin, but not being successful in picking up aught to eat, it was found a few days afterwards lying dead on the snow near the fort. Its extreme emaciation and the emptiness of its intestines showed clearly that it died from inanition."

"We learn from the same excellent authority that the American Wolf burrows, and brings forth its young in earths with several outlets, like those of a fox. Sir John Richardson saw some of their burrows on the plains of the Saskatchewan, and also on the banks of the Coppermine River. The number in a litter he states to vary from four or five to eight or nine. After

referring to the instances recorded in the narratives of Captain Parry and Captain Franklin of the association of the female wolves with the domestic dog, he relates that he was informed that the Indians endeavour to improve their sledge-dogs by crossing the breed with wolves, and he adds, that the resemblance between the northern wolves and the domestic dog of the Indians is so great, that the size and strength of the wolf seem to be the only difference. "I have more than once," says he, "mistaken a band of wolves for the dogs of a party of Indians; and the howl of the animals of both species is prolonged so exactly in the same key, that even the practised ear of an Indian fails at times to discriminate them."

"Captain Lyon gives the following account of the Esquimaux wolf trap. It is made of strong slabs of ice, long and narrow, so that a fox can with difficulty turn himself in it, but a wolf must actually remain in the position in which he is taken. The door is a heavy portcullis of ice, sliding in two well-secured grooves of the same substance, and is kept up by a line, which, passing over the top of the trap, is carried through a hole at the furthest extremity; to the end of the line is fastened a small hoop of whalebone, and to this any kind of flesh-bait is attached. From the slab which terminates the trap, a projection of ice, or a peg of wood or bone, points inwards near the bottom, and under this the hoop is lightly hooked; the slightest pull at the bait liberates it, the door falls in an instant, and the wolf is speared where he lies."

Fossil Canida.

"The remains of the Dog and Wolf have been found in Great Britain. If there were no historical records to prove that the wolf was once an inhabitant of these islands, its abundant remains would testify to the fact.—They were not present in any considerable number in the Bone-Caves of Kirkdale, which were so diligently examined by Dr. Buckland, but they have been found at Paviland in Glamorganshire, and at Overton near Plymouth. After alluding to the difficulty which was more particularly expressed by Cuvier of distinguishing between the Wolf and the Dog, Professor Owen referring to some specimens from Kent's Hole says:—"The more important points of concordance between the skull from Kent's Hole and those of the existing wolf leave no reasonable ground for doubting their specific identity; and the naturalist who does not admit that the dog and the wolf are of the same species, and who might be disposed to question the reference of the British Fossils described in the present section to the wolf must in that case resort to the hypothesis that there formerly existed in England a wild variety of dog having the low and contracted forehead of the wolf, and which had become extinct before the records of the human race. The conclusion however to which my comparison of the fossil and recent bones of the large *Canida* have led me is, that the wolves which our ancestors extirpated were of the same species as those which, at a much more remote period, left their bones in the limestone caverns by the side of the extinct bears and hyænas."

"Recognisable remains of the Dog have however been obtained from Bone-Caves. Dr. Schmerling has described and figured an almost entire skull, two right rami of lower jaws, a humerus, ulna, radius, and some smaller bones, indicating two varieties of the domestic dog, from some Bone-Caves near Liège."

ARTICLE XXXV.—On the Foxes of British North America.

GENUS VULPES, (Cuvier.)

DENTAL FORMULA.—*Incisive*, $\frac{6}{6}$; *Canine*, $\frac{1}{1}$ — $\frac{1}{1}$; *Molar*, $\frac{6}{7}$ — $\frac{6}{7}$.—42.

GENERIC CHARACTERS.—Muzzle pointed; pupil of the eyes forming a vertical fissure; upper incisors less curved than in the genus CANIS; tail long, bushy and cylindrical.

The arrangement of the teeth and the general osteological structure of the Wolves, Foxes, Domestic Dogs, and Jackals, are the same, and shew them all to be members of a single natural family, capable nevertheless of being subdivided into several inferior groups or genera. The foxes are distinguished by their lengthened muzzles, round heads, erect and triangular ears, long body, short limbs, and long bushy tail. The pupil of the eye also becomes elongated or linear in the day time, although they are nearly circular during the day. *

Audubon & Bachman remark that the "animals of this genus generally are smaller, and the number of species known greater, than among the wolves; they diffuse a foetid odour, dig, burrows, and attack none but the weaker quadrupeds, or birds, &c.

"The characters of this genus differ so slightly from those of the genus CANIS, that we are induced to pause before removing it from the subgenus in which it had so long remained. As a general rule, we are obliged to admit that a large fox is a wolf, and a small wolf may be termed a fox. So inconveniently large, however, is the list of species in the old genus CANIS, that it is, we think advisable to separate into distinct groups such species as possess any characters different from the true wolves.

"Foxes, although occasionally seen abroad during the day, are nocturnal in their habits, and their character is marked by timidity, suspicion and cunning. Nearly the whole day is passed by the Fox in concealment, either in his burrow under ground, in the fissures of the rocks, or in the middle of some large hollow tree top, or thick pile of brush-wood, where he is well hidden from any passing enemy.

"During the obscurity of late twilight, or in the darkness of night, he sallies forth in search of food; the acuteness of his organs of sight, of smell, and of hearing, enabling him in the most murky atmosphere to trace and follow the footsteps of small quadrupeds or birds, and pounce upon the hare seated in her form, or the partridge, grouse, or turkey, in their nests.

"Various species of squirrels, field rats and moles, afford him a rich repast. He often causes great devastation in the poultry yard; seizes on the goose whilst grazing along the banks of the stream, or carries off the lamb from the side of its mother.

"The cautious and wary character of the Fox, renders it exceedingly

* English Encyclopædia of Natural History, vol. 4, page 1234.

difficult to take him in a trap of any kind." * It is however practicable to take the most wary fox in a steel trap, provided it be carefully concealed."

The period of "gestation continues from 60 to 65 days. The cubs are from 5 to 9 in number, and like young puppies are born with hair, and are blind at birth. They leave their burrows generally when three or four months old, and in all predatory expeditions, each individual goes singly and plunders on his own account and for his own special benefit.

"The generic name is derived from the Latin word *Vulpes*, a Fox.

"There are about twelve well known species belonging to the genus—five of which exist in North America." †

The North American species are the following :—

1. The Red Fox, (*Vulpes fulvus*), of which the Black Fox, Silver Grey Fox, and Cross Fox, are considered varieties. Common in all the British Territories of North America.

2. The Arctic Fox, (*Vulpes lagopus*), inhabits the Arctic Regions, Hudson's Bay, Labrador, and Siberia. They do not range so far south as Canada.

3. The Grey Fox, (*Vulpes Virginianus*), inhabits the Southern States, where it is abundant. It is doubtful whether this fox has ever been seen so far north as Canada.

4. The Swift Fox or Kit Fox, (*Vulpes velox*), is a small animal similar to the Red Fox, but only one half of the size. Inhabits the prairies east of the Rocky Mountains and the plains of the Columbia River.

5. The Jackall Fox, (*Vulpes Utah*), is larger than the Red Fox, with a black throat and belly, and greyish brown above. Inhabits the Rocky Mountains, and probably ranges in the British Territories.

Of all these, the Red Fox is the most widely distributed throughout North America, and may therefore be considered as the reigning race among the Foxes of this continent. The following is the systematic description given by the eminent naturalists from whose works we have quoted :—

VULPES FULVUS, (Desm.) THE AMERICAN RED FOX.

SPECIFIC CHARACTERS.—"Fur reddish or fulvous; beneath the neck and belly white; chest grey; front part of the fore legs and feet, black; toes fulvous; tip of the tail, white." (*Fulvus*), Latin, of a yellow or reddish colour.

"This animal bears so strong a resemblance to the European Fox, (*Vulpes vulgaris*), that it was regarded as the same species by early naturalists. No one, however, who will compare specimens from both countries, can have a doubt of their being very distinct. Our Red Fox is a little the largest, its legs are less robust, its nose shorter and more pointed, the eyes nearer together, its feet and toes more thickly clothed with fur, its ears shorter, it has a finer and larger brush, and its fur is much softer, finer, and of a brighter colour.

* Audubon & Bachman, vol. 1, pages 44 and 45.

† Idem, page 45.

"It stands higher on its legs than the Grey Fox, (*V. Virginianus*;) and its muzzle is not so long and acute as in that species. It is formed for lightness and speed, and is more perfect in its proportions than any other species in the genus with which we are acquainted.

"The hair on the whole body is soft, silky, and lustrous; the ears are clothed with short hairs on both surfaces, and the feet and toes are so clothed with hair that the nails are concealed. The body of this species has a strong musky smell, far less disagreeable than that either of the skunk or mink. It becomes less offensive in a state of domestication.

COLOUR.—"Point of nose, outer extremity of ears, and outer surfaces of legs below the knees, black; forehead, neck, flanks, and back, bright reddish, and a little deeper tint on the back and fore-shoulders; around the nostrils, margins of the upper jaw, and chin, pure white; throat, breast, and a narrow space on the under surface, dingy white; extreme end of brush, slightly tipped with white; inner surface of ears, and base on the outer surface, yellowish. The hair on the body is of two sorts; long hairs interspersed among a dense coat of softer, brighter, and more yellowish fur; on the tail the longer interspersed hairs are more numerous, and many of them are quite black, giving the tail a more dusky appearance than the rest of the body.

"In addition to the distinct varieties of this species, the Black and Cross Fox, we have seen some shades of difference in colour in the red variety. In some, the colours on the back are considerably darker than in others.—We have seen several with the nose and chin nearly black, and in others the white tip at the tail is replaced with black."

DIMENSIONS.

	Feet.	Inches.
From point of nose to root of tail.....	2	6
Tail, (vertebræ).....	1	1
To end of hair.....	1	5
Height at shoulders.....	1	1
Height of ears posteriorly.....	0	2¾

The above description of the Red Fox is taken from AUDUBON AND BACHMAN'S QUADRUPEDS OF NORTH AMERICA, vol. 2, page 269, and in their account of the habits of the animal, the authors state that it is seldom or never to be met with south of the States of Kentucky and Tennessee. They frequent the coast of New Jersey in great numbers, where they find an abundance of food among the wild fowl, upon which they spring while they are asleep upon the ponds and creeks near the shore, but more particularly from the numerous wounded fowl which escape from the numerous gunners; also crabs and fish which are thrown up dead by the surf, and rabbits, and wading birds, in the summer.

Its habits in Canada are too well known to need any lengthened description here. It preys upon all the smaller productions of the farm-yard, and bears as bad a character here as its near relation the English Fox, the hero of many a fireside tale, has borne for ages in the olden world. That

the Fox is a most accomplished mouser, we know from our own personal observations. A few years ago, in the Township of Gloucester, near Ottawa, we shot a female fox which was at the time running across a meadow near the forest, and at a distance from the farm house. It was sunrise one morning about the middle of the month of May, and we fired at the animal at a long rifle range, more with the thought of frightening than with the hope of killing it. By chance, however, the ball took effect, and the Fox dropped suddenly dead. It had been stricken through the heart. Upon examination we found it to be a female who had spent perhaps the greater portion of the night in collecting food for her young. In her mouth were seven meadow mice and two small shrews, of what species we did not then think of ascertaining. It appears to us that these small quadrupeds must be much more rare in the spring than in the autumn, and that a single fox could collect so many in one excursion is a proof of their excellent capacity for hunting. It is probable that after she had caught one she left it in some safe place while she sought out and captured another, which she deposited along with the first, and then caught others. They were all lying lengthwise across her mouth, their tails and heads projecting more or less from between her lips. Had we known her mission, we certainly would have allowed her to pass without molestation. It is said, however, that both parents hunt for their young, and perhaps therefore the orphan family in this instance was not left totally destitute.

The Red Fox will catch birds, both by lying in wait for them and by trailing them up in the manner of a pointer dog, until watching an opportunity he can pounce or spring upon them. Audubon relates the following of a Grey Fox, and states that the Red Fox will hunt in the same way:—

“ On a cold, drizzly, sleety, rainy day, while travelling in Carolina, we observed a Grey Fox in a field of broom-grass, coursing against the wind, and hunting in the manner of a pointer dog. We stopped to witness his manoeuvres, suddenly he stood still, and squatted low on his hunches; a moment after he proceeded on once more, but with slow and cautious steps; at times his nose was raised high in the air, moving about from side to side. At length he seemed to be sure of his game, and went straight forward, although very slowly, at times crawling on the earth; he was occasionally hidden by the grass, so that we could not see him very distinctly; however, at length we observed him make a dead halt. There was no twisting or horizontal movement of the tail, like that made by the common house cat when ready to make a spring; but his tail seemed resting on the side, whilst his ears were drawn back and his head raised only a few inches from the earth; he remained in this attitude nearly half a minute, and then made a sudden pounce upon his prey; at the same instant the whirring of the distracted covey was heard, as the affrighted birds took wing; two or three sharp screams succeeded, and the successful prowler immediately passed out of the field with an unfortunate partridge in his mouth, evidently with the intention of seeking a more retired spot to make a dainty meal. We had a gun with us, and he passed within long gun shot of us. But, why wound or destroy him. He has enabled us for the first time to bear witness *that he is not only*

a dog, but a good pointer in the bargain; he has obeyed an impulse of nature, and obtained a meal in the manner in which it was intended by the wise creator that he should be supplied. He seized only a single bird, whilst man, who would wreak his vengeance on this poacher among the game, is not satisfied till he has killed half the covey with the murderous gun, or caught the whole breed in a trap, and wrung off their necks in triumph. Condemn not the Fox too hastily; he has a more strikingly carnivorous tooth than yourself, indicating the kind of food he is required to seek; he takes no wanton pleasure in destroying the bird, he exhibits to his companions no trophies of his skill, and is contented with a meal; whilst you are perhaps not satisfied when your capacious bird bag is filled." *

We have often seen the Red Fox in Canada hunting mice or birds in the fields, and at once recognise the truthfulness of the above picture. We have frequently observed his tail erected perpendicularly at the moment, and during the act of springing on his prey, a habit which gives him a grotesque and somewhat ridiculous appearance.

As to the speed of the Red Fox, it is said that in the open plains in the Western States, thirty gentlemen with one hundred hounds chased one for thirteen hours, when the horses and the whole pack of hounds were broken down, and the chase abandoned. These Foxes do not run so swiftly in Canada, and Sir John Richardson says they do not possess the wind of the English Fox. "It runs, says Sir John, for about a hundred yards with great swiftness, but its strength is exhausted in the first burst, and it is soon overtaken by a wolf or a mounted horseman. It may be that the animals of this species inhabiting the prairies or open forests of the West, are more accustomed to long flights, and therefore by natural habit better coursers than those of the densely wooded regions.

The Red Fox digs an extensive burrow in a sandy or gravelly bank, and provides it with a number of entrances, opening out to the surface in different directions. To this retreat he flies when pursued, and when the underground galleries are near the surface may be dug out, the sportsman first stopping up all the openings to prevent his escape.

The young are from four to six at a birth, and are brought forth in the early part of the spring.

The geographical distribution of the animal appears to be from the Hudson's Bay Territories lying north of Canada, south to Kentucky, and in a westerly direction from Labrador, across the continent to the Russian settlements.

* Audubon & Bachman, vol. 1, page 165.

VULPES FULVUS, (*Var Argentatus*.) THE SILVERY GREY OR BLACK FOX.

CHARACTERS.—*Size of the Red Fox*; body, silvery black; tip of tail, white; (*Argentatus*.) Latin, silvery.

The Silver Grey or Black Fox is considered a variety of the Red Fox, and is chiefly distinguished by his colour and the remarkable richness and beauty of his fur. The following is a full description of a specimen from the Hudson's Bay Territories:—

“Body clothed with two kinds of hair; the longest or outer hair extends in some parts two inches beyond the under or shorter fur, especially on the neck, beneath the throat, behind the shoulders, along the flanks, and on the tail; this hair is soft, glossy, and finer than even that of the pine marten.

“The under fur is unusually long and dense, measuring in some places two inches, and is exceedingly fine, feeling to the hand as soft as the finest sea-island cotton; this under fur surrounds the whole body, even to the tail, on which it is a little coarser, and has more the appearance of wool; it is shortest on the legs and forehead, and least dense on the belly; the hairs composing this fur, when viewed separately, exhibit a crimped or wavy appearance; on the ears and nose scarcely any long hairs are to be seen, these parts being thickly clothed with fur.

“The soles of the feet are so thickly clothed with fur, that no callous spots are visible.

“The under colour is uniformly, blackish, brown, or chocolate; the long hairs are brown at their roots, then silver grey, and are broadly tipped with black; the hairs on the neck, and on the dorsal line extending to the root of the tail, are black, forming a broad black line at the neck, which narrows towards the tail.

“Chin, throat, and whole under surface, brownish black; a tuft of white hairs on the neck, near the chest; another white tuft near the umbilicus; upper parts, glossy, silvery, black; sides sprinkled with many shining white hairs, which produce a somewhat hoary appearance; tail brownish black, to rear the extremity, where it is broadly tipped with white.

DIMENSIONS.

	Feet.	Inches.
Nose to root of tail.....	2	5
Length of tail.....	1	7
Height of ear.....	0	2¾
From nose to end of ear stretched back.....	0	8½
From nose to eyes.....	0	3½

The rich and beautiful fur of the Silver Grey Fox is not used in this country. Only the luxurious nobles of Russia and other parts of Europe indulging in material so costly. A single skin of the first quality is here £25, and when it reaches its final destination in the markets of the Eastern world is perhaps sold for from 50 to 100 guineas. It is by no means abundant. Sir John Richardson states that upon an average, only four or

five of these skins are procured in a season at any one of the posts in the fur countries.

This Fox presents considerable variations, both in size and colour.—Some of them are brilliant black, with the exception of the end of the tail, which is invariably white. Other specimens are bluish grey, and many are tinged with a cinerous colour on the sides; it perhaps is most commonly obtained, with parts of its fur hoary, the shiny black coat being thickly interspersed with white or silvery blue tipped hairs.

Three years since, in the spring of 1853, Mr. Clarke, of the Township of Osgoode, near the City of Ottawa, discovered a burrow of Silver Grey-Foxes in that Township, and succeeded in capturing two of the young ones. His dog caught one of the old ones, and Mr. Clarke endeavoured to secure it, but it bit him so severely that he was obliged to let it escape. One of the young animals was intensely black over every portion of his body, except the point of his tail, in which there were a few white hairs only. The other was a beautiful silver grey. This fact proves that the Silver Grey Fox and the Black Fox are only varieties of the same species, since both, in this well authenticated instance, were the progeny of the same parents and at the same birth. These two animals were exhibited with some other animals by the members of the Mechanics Institute and Athenaeum, at their exhibition, on the occasion of the visit of Lord Elgin in 1853. They were afterwards purchased by Mr. J. Dennison, Fur Dealer in Ottawa, for £15. The Silver Grey hung himself with his chain, and the Black one, owing to his having on more than one occasion nearly succeeded in making his escape, was killed. Mr. Dennison informs us that he afterwards sold the two skins for £30. He is a fortunate trapper who can display among the contents of his pack a couple of good Silver Grey Foxes.

This Fox is chiefly found in the colder portions of the British Territories. They are only rarely to be met with south of the St. Lawrence.

The Grey Fox of the Southern States (*Vulpes Virginianus*), in a very different animal, and its fur is not so valuable. There is no fur produced in North America so precious as that of the Silver Grey Fox. The habits of the animal appears to be in no respect different from those of the Common Red Fox.

VULPES FULVUS, (*var. decussatus*), THE CROSS FOX.

CHARACTERS.—*A cross on the neck and shoulders, and a longitudinal stripe on the under surface black; (Decussatus.) Latin, crossed.*

Sir John Richardson, and in fact most naturalists, hunters, and Indians, regard the Cross Fox as a mere variety of the Red Fox. He says I found on inquiry that the gradations of colour between characteristic specimens of the Cross and Red Fox, are so small that the hunters are often in doubt with respect to the proper denomination of the skin; and I was frequently told, "this is not a cross Fox yet, but becoming so." It is worthy of remark, moreover that the European Fox (*Vulpes vulgaris*) is subject to similar

varieties, and that the *Canis crucigera* of Gesner, differs from the latter animal in the same way that the American Cross Fox does from the Red one.

The Cross Fox is frequently taken in Canada, and differs only from the true Red Fox in the fur being of a finer quality, and the presence of a cross upon the shoulders. The following is a full description :—

“Form agrees in every particular with that of the Common Red Fox ; fur rather thick and long, but not thicker or more elongated than in many specimens of the Red Fox that we have examined ; soles of the feet densely clothed with short woolly hairs, so that the callous spots at the roots of the nails are scarcely visible ; a black longitudinal stripe more or less distinct on the under surface.

COLOUR.—“Front of the head and back, dark grey ; the hairs being black at the roots, yellowish white near the ends, and but slightly tipped with black, so that the light colour of the under part of each hair showing through gives the surface a grey tint, with these hairs a few others are mixed that are black throughout their whole length.

“The soft fur beneath these long hairs is of a brownish black ; inner surface of ears and sides of the neck from the chin to the shoulders, pale reddish yellow ; sides behind the shoulders towards the top of the back, slightly ferruginous ; fur underneath the long hair, yellowish ; tail, dark brown ; fur beneath, the long hairs yellowish at base, broadly tipped with black ; a line along the under surface for half its length, and broadest at its termination, black ; a few white hairs intermixed, but not a sufficient number to alter the general colours. The yellowish tint on each side of the neck and behind the shoulders is divided by a longitudinal dark brown band on the back, crossed at right angles by another running over the shoulders and extending over the fore legs, forming a cross. There is another cross yet more distinctly marked upon the chest ; a black stripe, extending downward from the throat toward the belly, being intersected by another black line which reaches over the chest from the inside of one fore-leg to the other.—Hence the name of this animal does not originate in its ill nature, or by reason of its having any peculiarly savage propensity, as might be presumed, but from the singular markings we have just described.” *

The habits of this animal are the same as those of the Red Fox. It is not so common, and its skin is worth in the market about three times as much.

The three foxes described in the preceding pages are all that inhabit the Canadas, but farther north we have another and very distinct species within the British Territories.

* Audubon & Bachman, vol. 1, page 46.

VULPES LAGOPUS, THE ARCTIC FOX.

SPECIFIC CHARACTERS:—*Ears rounded, short, and folded at the edges; cheeks with a ruff; colour in summer, brown; in winter, white. Specific name from the Greek, (Lagos,) a hare, and (pous) the foot, literally the hare-footed Fox.*

The head of this Fox is not so much pointed as in other species of Fox, and the ears present the appearance of having been cropped.

“The cheeks are ornamented by a projecting ruff, which extends from behind the ears quite round the lower part of the face, to which it gives a pleasing appearance. The legs are long, the soles of the feet are covered with dense woolly hair, and the claws are long and strong.

“In winter this animal is white, but in summer it becomes brown, the change taking place in May. It is well adapted to endure the severest cold, and the provision which nature has made of a hairy covering, for the soles of its feet enables it to run upon the glare ice without slipping, or upon the snow without sinking into it.”

The following description of its habits is given by Audubon and Bachman :—

“The Arctic Fox is a singular animal, presenting rather the appearance of a little stumpy, round-eared cur, than that of the sharp and cunning-looking Foxes of other species which are found in more temperate climes. The character (for all animals have a character) and habits of this species are in accordance with its appearance; it is comparatively unsuspecting and gentle, and is less snappish and spiteful, even when first captured, than any other Fox with which we are acquainted.

“At times there is seen a variety of this Fox, which has been called the Sooty Fox, but which is in all probability only the young, or at any rate is not a permanent variety, and which does not turn white in winter, although the species generally becomes white at that season. It is said likewise that the white Arctic Foxes do not assume a brown tint in the summer.—Richardson says that only a majority of these animals acquire the pure white dress even in winter; many have a little duskiess on the nose, and others, probably young individuals, remain more or less coloured on the body all the year. On the other hand, a pure white Arctic Fox is occasionally met with in the middle of summer, and forms the variety named *Kakkortak* by the Greenlanders.

“Mr. William Morton, ship’s steward of the *Advance*, one of Mr. Henry Grinnell’s vessels sent in search of Sir John Franklin and his party, although not a naturalist, has furnished us with some account of this species. He informs us that while the vessels (the *Advance* and *Rescue*) were in the ice, the men caught a good many Arctic Foxes in traps made of old empty barrels on the ice; they caught the same individuals in the same trap several times, their hunger or their want of caution leading them again into the barrel when only a short time released from captivity.

“They were kept on board the vessels for some days, and afterwards let loose; they did not always appear very anxious to make their escape from the ships, and those that had not been caught sometimes approached vessels on the ice, where, first one would appear, and after a while another, showing that several were in the neighbourhood. They were occasionally observed on the rocks and snow on the land, but were not seen in packs like wolves; they do not take to the water or attempt to swim.

“These Foxes when they see a man do not appear to be frightened; they run a little way, and then sit down on their haunches like a dog, and face the enemy before running off entirely. They are said to be good eating, the crews of the vessels having feasted on them, and are fat all the winter.—They were occasionally seen following the polar bear to feed on his leavings, seals, flesh of any kind, or fish.

“Those they captured were easily tamed, seldom attempting to bite even when first caught, and by wrapping a cloth around the hand some of them could be taken out of the barrel and held, not offering more resistance than a snap at the cloth.

“Several beautiful skins of this animal were brought home by Dr. E. K. Kane, the accomplished surgeon of the expedition, and have since been presented by him to the Academy of Natural Sciences at Philadelphia.

“Captain Lyon, during two winters passed on the Melville peninsula, studied with attention the manners of several of these animals. He says:—“The Arctic Fox is an extremely cleanly animal, being very careful not to soil those places where he eats or sleeps. No unpleasant smell is to be perceived even in a male, which is a remarkable circumstance. To come unawares on one of those creatures is, in my opinion, impossible, for even when in an apparently sound sleep they open their eyes at the slightest noise which is made near them, although they pay no attention to sounds when at a short distance. The general time of rest is during the daylight, in which they appear listless and inactive; but the night no sooner sets in than all their faculties are awakened; they commence their gambols, and continue in unceasing and rapid motion until the morning. While hunting for food, they are mute, but when in captivity or irritated, they utter a short growl like that of a young puppy. It is a singular fact, that their bark is so undulated as to give an idea that the animal is at a distance, although at the very moment he lies at your feet.

“Although the rage of a newly caught Fox is quite ungovernable, yet it very rarely happened that on two being put together they quarrelled. A confinement of a few hours often sufficed to quiet these creatures; and some instances occurred of their being perfectly tame, although timid, from the first moment of their captivity. On the other hand, there were some which, after months of coaxing, never became more tractable. These we suppose were old ones.

“Their first impulse on receiving food is to hide it as soon as possible, even though suffering from hunger, and having no fellow-prisoners of whose honesty they are doubtful. In this case snow is of great assistance, as being

easily piled over their stores, and then forcibly pressed down by the nose. I frequently observed my Dog-Fox, when no snow was attainable, gather his chain into his mouth, and in that manner carefully coil it so as to hide the meat. On moving away, satisfied with his operations, he of course had drawn it after him again, and sometimes with great patience repeated his labours five or six times, until in a passion he has been constrained to eat his food without its having been rendered luscious by previous concealment. Snow is the substitute for water to these creatures, and on a large lump being given to them they break it in pieces with their feet and roll on it with great delight. When the snow was slightly scattered on the decks, they did not lick it up as dogs are accustomed to do, but by repeatedly pressing with their nose collected small lumps at its extremity, and then drew it into the mouth with the assistance of the tongue."

"In another passage, Captain Lyon, alluding to the above-named Dog-Fox, says:—"He was small and not perfectly white; but his tameness was so remarkable that I could not bear to kill him, but confined him on deck in a small hutch, with a scope of chain. The little animal astonished us very much by his extraordinary sagacity, for during the first day, finding himself much tormented by being drawn out repeatedly by his chain, he at length, whenever he retreated to his hut, took this carefully up in his mouth, and drew it so completely after him that no one who valued his fingers would endeavour to take hold of the end attached to the staple."

"Richardson says that notwithstanding the degree of intelligence which the anecdotes related by Captain Lyon shew them to possess, they are unlike the Red Fox in being extremely unsuspecting; and instances are related of their standing by, while the hunter is preparing the trap, and running head-long into it the moment he retires a few paces. Captain Lyon received fifteen from a single trap in four hours. The voice of the Arctic Fox is a kind of yelp, and when a man approaches their breeding places they put their heads out of their burrows and bark at him, allowing him to come so near that they may easily be shot.

"They appear to have the power of decoying other animals within their reach, by imitating their voices. "While tenting, we observed a Fox prowling on a hill side, and heard him for several hours afterwards in different places, imitating the cry of a brentgoose." They feed on eggs, young birds, blubber, and carrion of any kind; but their principal food seems to be lemmings of different species.

"Richardson thinks the "brown variety," as he calls it, the more common one in the neighbourhood of Behring's Straits. He states that they breed on the sea coast, and chiefly within the Arctic circle, forming burrows in sandy spots, not solitary like the Red Fox, but in little villages, twenty or thirty burrows being constructed adjoining to each other. He saw one of these villages on Point Turnagain, in latitude $68\frac{1}{2}^{\circ}$. Towards the middle of winter, continues our author, they retire to the southward, evidently in search of food, keeping as much as possible on the coast, and going much farther to the southward in districts where the coast line is in the direction

of their march. Captain Parry relates that the Arctic Foxes, which were previously numerous, began to retire from Melville peninsula in November, and that by January few remained. "Towards the centre of the continent, in latitude 65° , they are seen only in the winter, and then not in numbers; they are very scarce in latitude 61° , and at Carleton House, in latitude 53° , only two were seen in forty years. On the coast of Hudson's Bay, however, according to Hearne, they arrive at Churchill, in latitude 59° , about the middle of October, and afterwards receive reinforcements from the northward, until their numbers almost exceed credibility. Many are captured there by the hunters, and the greater part of the survivors cross the Churchill river as soon as it is frozen over, and continue their journey along the coast to Nelson and Severn rivers. In like manner they extend their migrations along the whole Labrador coast to the gulf of St. Lawrence. Most of those which travel far to the southward are destroyed by rapacious animals; and the few which survive to the spring breed in their new quarters, instead of returning to the north. The colonies they found are however soon extirpated by their numerous enemies. A few breed at Churchill, and some young ones are occasionally seen in the vicinity of York factory. There are from three to five young ones in a litter."

"The trap in which the Arctic Fox is taken by the Esquimaux, is described by authors as simple: it consists of a little hut built of stone, with a square opening on the top, over which some blades of whalebone are extended nearly across, so as to form an apparently secure footing, although only fastened at one end, so that when the animal comes on to them to get the bait, they bend downward and the Fox is precipitated into the hut below, which is deep enough to prevent his jumping out, the more especially because the whalebone immediately rises again to its position, and the bait being fastened thereto, several Foxes may be taken successively. Other traps are arranged so that a flat stone falls on the Fox when he, by pulling at the bait, disengages the trigger. These Foxes are also caught in traps made of ice (in which wolves are taken at times by the Esquimaux). These traps are thus described by Dr. Richardson, and are certainly composed of the last material we, dwellers in more favoured lands, would think of for the purpose: "The Esquimaux wolf-trap is made of strong slabs of ice, long and narrow, so that a Fox can with difficulty turn himself in it, but a wolf must actually remain in the position in which he is taken. The door is a heavy portcullis of ice, sliding in two well-secured grooves of the same substance, and is kept up by a line, which, passing over the top of the trap, is carried through a hole at the farthest extremity; to the end of the line is fastened a small hoop of whalebone, and to this any kind of flesh-bait is attached. From the slab which terminates the trap, a projection of ice or a peg of wood or bone points inwards near the bottom, and under this the hoop is slightly hooked; the slightest pull at the bait liberates it, the door falls in an instant, and the wolf (or Fox) is speared where he lies."

"In speaking of the *Sooty Fox*, which is only a variety of the present species, Dr. Richardson says: "On one occasion during our late coasting

voyage round the northern extremity of America, after cooking our supper on a sandy beach, we had retired to repose in the boats, anchored near the shore, when two Sooty Foxes came to the spot where the fire had been made, and carrying off all the scraps of meat that were left there, buried them in the sand above high water mark. We observed that they hid every piece in a separate place, and that they carried the largest pieces farthest off."

GEOGRAPHICAL DISTRIBUTION.

"Arctic Foxes have been seen as far north on the American continent as man has ever proceeded. They are numerous on the shores of Hudson's Bay, north of Churchill, and exist also in Bhering's straits; towards the centre of the continent in latitude 65° , they are seen only in the winter, and then not in numbers. They are very scarce in latitude 61° , and at Carlton House in latitude 53° , only two were seen in forty years. On the coast of Hudson's Bay, however, according to Hearne, they arrive at Churchill in latitude 59° , about the middle of October, and afterwards receive reinforcements from the northward. On the eastern coast of America they are found at Labrador, where they have been seen occasionally in considerable numbers: a few have been also observed in the northern parts of Newfoundland, about latitude 52° .

"On the eastern continent they are found in Siberia, and in all the Arctic regions."

ARTICLE XXXVI.—*On the Canadian Otter, (Lutra Canadensis).*

GENUS LUTRA, (Ray.)

DENTAL FORMULA.—*Incisive*, $\frac{5}{5}$; *Canine*, $\frac{1}{1}\frac{1}{1}$; *Molar*, $\frac{5}{5}\frac{5}{5}$.—36.

GENERIC CHARACTERS.—"The second inferior incisors on each side a little receding in most of the species; the canine much dilated, hooked; first superior molar, small, blunt, and sometimes deciduous; the second, cutting; the third of similar form, but larger; the fourth with two external points, but furnished with a strong spur on the inner side; the fifth has externally three small points, with a broad spur internally. The inferior molars in this genus vary from five to six, the first being wanting in some of the species.

"Head, large and flattish, terminating in a blunt muzzle; ears, short and round; tongue, slightly papilous; body, long and slender; legs, short; toes, five on each foot. In some of the species the fifth toe on the hind foot is rudimental; toes webbed, armed with short claws, which are not retractile; tail not so long as the body, thick and flattened horizontally.

"Body covered externally with long rigid and glossy hair, with a softer, shorter, downy fur intermixed.

"On each side of the anus there is a small gland secreting fetid matter.

"All the species are good swimmers, live along the banks of the rivers and ponds, and feed on fish.

"The generic appellation is derived from *Lutra*, an Otter; from the Greek, *Louo*, to wash.

"There are eleven species enumerated by authors, inhabiting the following countries;—Europe, 1; Island of Trinidad, 1; Guyana, 1; Brazil, 1; Kamschatka, 1; Java, 1; Malay, 1; Pondicherry, 1; The Cape of Good Hope, 1; and North America, 2. *

LUTRA CANADENSIS (SABINE), THE CANADA OTTER.

SPECIFIC CHARACTERS.—*Dark glossy brown; chin and throat, dusky white; larger than the European Otter.*

The Canadian Otter inhabits the whole of North America, and it is supposed a portion of South America also. Specimens procured from the Southern countries of the continent, such as Texas and Carolina, can scarcely be distinguished from those brought from the extreme North, the fur being of nearly the same quality, and the colour being only a little lighter in those from the warm climates. Throughout the whole of this vast territory, the animal is found in the rivers and lakes of every district, except indeed where extirpated by man in the most densely populated tracts of country.

The head of the Otter is large, and nearly of a globular form; the nose blunt and naked; the lips thick; ears rounded, slightly ovate, and closer together than in the Otter of Europe, (*Lutra vulgaris*), and clothed densely with short hair on both surfaces. The body is long and cylindrical; the neck long; the legs short and stout; moustaches very rigid, like bristles; soles of the feet thinly clothed with hair; between the toes, tubercles at the roots of the claws, naked; feet webbed to the nails; tail stout, gradually tapering toward the extremity, depressed at the base, continuing flattened through half its length; at the base there are two oval glands. The longer hairs covering the fur are glossy and rigid; fur soft, dense, and nearly as fine as that of the Beaver, continuing through the whole extent of the body, even to the extremity of the tail, but shorter on the forehead and extremities. The general colour of the animal is a rich chesnut brown, a shade lighter on the whole of the under surface.

This animal brings forth one litter annually, about the middle of April, in the northern countries, and about a month earlier in the southern. Its nest is constructed either in a hole in a bank near the water or in the hollow of a large tree. These nests are large—composed of small sticks, leaves, and soft grass, and are in all cases above the reach of high water, and made comfortable by being well protected and sheltered from the rains.

The Otter is a famous swimmer and diver, and can easily capture almost any kind of fish. Audubon states that in one locality, near Charleston, in the Southern States, where they were very numerous about thirty years since, he went one morning to observe them, and in the space of two hours counted forty-six. They came down with the receding tide in groups, or families of five or six together, and ascended the different creeks in the salt marshes and engaged in capturing mullets. In most cases they came to the bank with a fish in their mouth, despatching it in a minute, and then again hastened in after more prey. As the tide rose, they returned up the river again to their more secure retreats.

* Audubon & Bachman, vol. 2, page 1.

Our friend A. Dickson, Esq., who has studied their habits and kept them in confinement in Canada, has furnished us with the following accounts:—

“The Otter lives principally on fish, but will eat any kind of flesh readily. It is surprising to see the quantity of fish it will consume during the twenty-four hours; night and day it is on the move, either in search of food or play.

“The habits of the Otter differ much from those of the Beaver, who has a local habitation. The Otter, on the contrary, is always on the march from one lake or pond to another, yet it regularly visits particular places in its rounds, where it has what is called a slide, on the bank of a lake or river, where it rolls or draws itself along with its belly on the ground. Near these places it has its hole in the bank. It may appear strange, yet I have known an Otter bring forth her young in the hollow of a fallen tree a mile from any water.

“The Otter is hunted for the value of its skin, its flesh being very rank and unpalatable: yet Indians and hunters are often glad to partake of it when other food is scarce.

“The Otter is generally killed by trapping, sometimes in the water, other times on land, on their slides, covering the trap with leaves, and when caught by the fore foot, does not leave his foot in the trap and escape like the Beaver and Musk-rat. It is often shot by the hunter in his wanderings, and occasionally it is killed when travelling through the wood if the hunter meets it, especially if he has a good dog. If the Otter make his escape to a pond or lake when pursued, ten chances to one he will immediately leave it on the opposite side and make his way to some other lake. If the dog has been in the habit of hunting the Otter, he will follow round the lake until he gets on the trail. I have known an Otter to pass five small lakes and then take refuge in a hollow tree, where he was killed. It requires a very good dog to master an Otter, as they have sharper teeth than any quadruped in Canada, and their thick loose skin protects them.

“The Otter is a playful and affectionate pet when taken young. I had one as much domesticated as a dog,—it would follow me all over the farm or village, but he preferred a stroll along the bank of the river, or an excursion in a canoe; occasionally he would catch a fish, but the number of bullfrogs he would kill was astonishing. I never saw him eat any, but he appeared to be pleased with the sport of catching them and letting them go the moment he got his eye on a fresh one. In one of those excursions he appeared to be in trouble, and made a great noise; I went back to see what was the matter and found he had got an over-grown mud-turtle among the weeds on the shore, he appeared pleased when I went to his assistance, as he could do nothing with his game. I do not think an Otter is able to kill a large turtle; yet, I found he relished eating it after it was cut up with the axe.

“When I took the fishing rod into my hand, he went into extacies. I

never saw a dog fonder of a gun than he was of the fishing rod. He would go perhaps a dozen times a day fishing on his own account, always accompanied by a young collie dog, which stood on the top of the boom, watching every movement of his friend among the finny tribe; before the Otter made a den for himself, the dog and he used to sleep huddled up together as if they belonged to the same litter.

"I frequently used to cut up a fish into small pieces and throw it off the bridge; before it reached the water the Otter was on its way towards it as straight as a line, but before he could reach the desired object a number of chub would be contending with eagerness for it. Nekeek soon put an end to the dispute by grabbing the first he could catch; if the chub escaped, he always seized the piece of fish that was thrown in. In such cases he immediately swam under water, sometimes on his back and sometimes on his feet, but always came on shore to eat his food; when doing so, he held his head up and shut his eyes, which easily accounts for the success I had in shooting them when eating. When done fishing he was sure to rub himself upon the carpet if he could get into the house, when he failed in that, he would rub himself against some friend's legs, or on any of the dogs belonging to the place if he could catch them asleep. Nekeek was like many in the world, he had his friends and his enemies; when he was young he was fed on cow's milk, and was often favoured with it from the teat; it was surprising to see how he could catch it in his mouth; but one cow not relishing such practices, upset both milker and pail, and almost killed his Ottership: after some time he recovered, but never forgot the injury, indeed the feeling appeared to be reciprocal whenever they met, both gave signs of displeasure.

"He commenced to dig a hole in the garden and formed comfortable lodgings under the platform at the door, where he spent his nights on a bed of straw which he carried in.

"Like all other animated things, Nekeek had an end, and like many human beings, he perished in the fluid in which he took greatest delight.—He had some friends about the mills who used to give him an eel for his breakfast, hence he spent a part of his time there, and by some means got into a reaction wheel where he was drowned. Perhaps if the favourite horse or cow had died, there would not have been as much lamentation as there was for poor Nekeek for weeks afterwards. Collie would be seen for hours on the boom looking for his friend."

The capability of the Otter for domestication, is not confined to the American species. "Goldsmith mentions an Otter which went into a gentleman's pond at the word of command, drove the fish up into a corner, and having seized on the largest, brought it out of the water to its master. Daniel, Bewick, and Shaw, record instances of the animal's docility in this way. Mr. Bell and Mr. McGillivray both corroborate the fact. The latter has collected the following anecdotes:—Mr. McDiarmid, in his amusing "Sketches from Nature," gives an account of several domesticated Otters, one of which, belonging to a poor widow, when led forth plunged into the Urr or the neighbouring burns and brought out all the fish it could find.—

Another, kept at Crosbie House, Wigtonshire, evinced a great fondness for gooseberries, fondled about her keeper's feet like a pup or kitten, and even seemed inclined to salute her cheek when permitted to carry her freedom so far. A third belonging to Mr. Monteith, of Carstairs, was also very tame, and though he frequently stole away at night to fish by the pale light of the moon and associate with his kindred by the river side; his master was, of course, too generous to find any fault with his peculiar mode of spending his evening hours. In the morning he was always at his post in the kennel, and no animal understood better the secret of keeping his own side of the house. Indeed his pugnacity in this respect gave him a great life in the favour of the gamekeeper, who talked of his feats wherever he went, and avowed besides, that if the best cur that ever ran 'only daured to grin' at his protege, he would soon 'mak his teeth meet through him.' To mankind, however, he was much more civil, and allowed himself to be gently lifted by the tail, though he objected to any interference with his snout, which is probably with him the seat of honour." *

Audubon on two occasions domesticated the Canada Otter. He states "The individuals had been captured quite young, and in the space of two or three days became as tame and gentle as the young of the domestic dog.—They preferred milk and boiled corn meal, and refused to eat fish or meat of any kind until they were several months old. They became so attached to us, that at the moment of their entrance into our study they commenced crawling into our lap—mounting our table, romping among the books and writing materials, and not unfrequently upsetting our inkstand, and disarranging the papers."

He has also seen them amusing themselves at their slides, and says, "The Otters ascend the bank at a place suitable for their diversion, and sometimes where it is very steep, so that they are obliged to make quite an effort to gain the top; they slide down in rapid succession where there are many at a sliding place. On one occasion we were resting ourselves on the bank of Canoe Creek, a small stream near Henderson, which empties into the Ohio, when a pair of Otters made their appearance, and not observing our proximity, began to enjoy their sliding pastime. They glide down the soap-like muddy surface of the slide with the rapidity of an arrow from a bow, and we counted each one making twenty-two slides before we disturbed their sportive occupation." This habit of the Otter of sliding down from elevated places to the borders of streams is not confined to cold countries, or to slides on the snow or ice, but is pursued in the Southern States where the earth is seldom covered with snow, or the waters frozen over. Along the reserve dams of the rice fields of Carolina and Georgia, these slides are very common. *

The fur of the Otter is highly esteemed by manufacturers, and a good skin is worth from six to ten dollars, according to size and fluctuation of the market.

* *English Encyclopædia*, vol. 3, page 554.

* *Audubon & Bachman*, vol. 2, page 8.

ARTICLE XXXVII.—*On the Bob-link or Rice-Bird, (Dolichonyx orzivora.)*

At the present season of the year almost every meadow in the country possesses one or more families of Bob-links, birds not only remarkable for the richness of their music, but also for the changes of their plumage and the extent of their migrations. The female of this species much resembles a small blackbird in form, but her colour is yellowish-brown, with blackish streaks running from the head in the direction of the tail. The male during the spring and summer is easily distinguished by a large cream-coloured or whitish patch upon the back of his neck. He has also a white spot on each wing, and his back is yellow. They inhabit and breed in the meadows, never in the woods. A couple of hours walk into the country will be well repaid by hearing the extraordinary song of this bird, and witnessing the amusing pomposity of his motions.

These birds arrive in Canada in the month of May, and immediately settle themselves in the meadows, where the female commences preparations for rearing her young, while the male cheers her with his music. The nest is constructed on the ground, composed of leaves and coarse grass, and lined on the inside with the same materials, but of a finer quality. The eggs are five, of a bluish white, and the young when brought forth are of the colour of the female.

“The song of the male, while the female is sitting, is singular and very agreeable. Mounting and hovering on wing at a small height above the field, he chaunts out such a jingling melody of short, variable notes, uttered with such seeming confusion and rapidity, and continued for a considerable time, that it appears as if half a dozen birds of different kinds were singing together. Some idea may be formed of this song by striking the high keys of a pianoforte at random, singly and quickly, making as many sudden contrasts of high and low notes as possible. Many of the tones are in themselves charming, but they succeed each other so rapidly that the ear can hardly separate them. Nevertheless the general effect is good, and when ten or twelve are all singing on the same tree, the concert is extremely pleasing.” *

When there are a number breeding in the same field, often a small flock of the males may be heard at once from the same tree, commencing one after another, and sometimes ceasing all at the same time. The rich jangle of notes poured forth by a large party is extremely interesting. The song consists of a rapid rigmorole of notes somewhat like *kukle-eye-ko wukle-any-kang kang kukle-ee-ke kilik kilik-ilik-ang kang*, &c., uttered with great rapidity, and the sounds running into each other towards the conclusion. It is to be observed that the bird, on some occasions, commences this song several times before he gets through with it, as if he were endeavouring to recollect it.

The migrations and changes of plumage of this little bird are exceedingly curious. During the breeding season, May, June, and July, they seem to spread over all the middle portion of the continent, as far north as the 54th degree of north latitude. In July the male begins gradually to lose his remarkable dress, and to assume that of the female. In August the sexes cannot be distinguished from each other, except by dissection. Males, females, and the young of that season, then all wear the same homely garb. The male has also lost his song. They have but one brood in the season, and during the early portion of the autumn, innumerable families congregate into prodigious swarms and pour down upon the southern countries. In Canada they are sometimes called during their autumnal flight "little brown blackbirds," and occasionally they commit great depredations upon the fields of oats. Few persons then suspect that they and the Bob-links are the same birds, as their dress and habits are different, and the only note they utter is a short and sharp "klink." The Bob-link of the summer is an inoffensive and highly amusing fellow, delighting all observers with his song, and feeding only upon insects and their larvæ; but he of the autumn is a ruthless and hated depredator, devastating whole fields of grain. Their ravages in the South are of a much more formidable character than they are in the British Provinces. Wilson says "They collect in great multitudes, and pour down upon the oat-fields of New England like a torrent, depriving the proprietors of a good part of their harvest; but, in return, often supply his table with a very delicious dish. From all parts of the North and Western regions, they direct their course towards the South, and about the middle of August revisit Pennsylvania, on their route to winter quarters. For several days they seem to confine themselves to the fields and uplands; but as soon as the seeds of the reed are ripe, they resort to the shores of the Delaware and Schuylkill in multitudes; and these places during the remainder of their stay appear to be their grand rendezvous. The reeds or wild oats, furnish them with such abundance of nutritious food, that in a short time they become extremely fat, and are supposed by some of our epicures to be equal to the famous ortolans of Europe. Their note at this season is a single *chink*, and is heard overhead with little intermission from morning to night." On their first arrival in the Southern States from the North in the autumn they are lean, but in a few days they become so fat that each bird is said to be nothing more than a compact ball of delicious meat. They are at this season called "Reed-birds" or "Rice-birds," from their feeding upon rice, or the seeds of the wild oats or reeds. They are slain in myriads, and exposed for sale in all the markets of the Southern cities. In "LEWIS' AMERICAN SPORTSMAN," a book which contains a good deal of Natural History as well as sporting information, the author says "The war of musketry is now heard incessantly from bright morning till dark night, all along the banks of our rivers, and the markets are soon overstocked with the innocent victims of many an old rusty barrel, that is only brought into requisition in Reed-bird season, as it most frequently is at this time of the year. The birds spoil very soon after being killed; and consequently remain but a short time in the hands of the

hucksters and game dealers, who are very glad to dispose of them from twelve to twenty-five cents per dozen, according to the returns of the previous day's shooting, which, of course, depends in a great measure upon the wind and weather.

"Reed-birds are shot on the meadows below our city, (Philadelphia,) or in the reeds from about; great numbers are brought down at a single shot, as they generally congregate in enormous flocks towards sunset; it is no uncommon thing to kill four or five dozen from the well-directed fire of a double-barrelled gun. It would appear incredible to state all the numbers that have been reported as killed at one discharge of an old musket or other heavy gun.

"We will, therefore, confine ourselves to one single instance, in which thirteen dozen were picked up, the result of a raking fire poured into a flock from an old fowling-piece that "scattered most confoundedly." This is not by any means the largest number we have heard of being bagged at one *coup de fusil*; but the account is well authenticated, and within bounds of credence, and we give it to our readers as such, for we have no reason to doubt the veracity of the party who told us.

"During the last year or two, a French gentleman of our city has been amusing himself in netting these Birds upon the meadows, and has been quite successful in the sport, catching immense numbers, oftentimes several hundreds at a single draw of the net. The process of taking Reed-Birds in this way is very simple, but as we are opposed to all kinds of poaching and unsportsman-like modes of taking any kind of winged game, we will not dwell longer on the subject.

"The flavor of the Reed-Bird is extremely juicy and rich, and assimilates as near as possible to that of the Ortolan of Europe, which interesting fact we very unwittingly tested at a celebrated *café*, in company with some others of our green countrymen, who were in Paris at the same time; and greatly to our surprise as well as indignation, were forced to pay for the information at the rate of a dollar per head, for these delicate little morceaux. At this rather *recherché* but expensive feast—for we devoured the poor Ortolans in nearly the same numbers as we were wont to do the Reed-Birds, at the height of the season in our own city—we think that the flavor of the French Bird was indelibly stamped upon our palate, in about perhaps the same ratio as the impression made at the time upon our purse, which, *en passant*, was not very light, we can assure the reader, as we were all Philadelphians, and consequently death on Reed-Birds, and, *in course*, Ortolans also. As far as we can recollect the particulars of this *dejeuner à la fourchette*—which, by the by, afforded us all much merriment for a long time afterwards—the company, pretty generally, when partaking of the feast, in the goodness of their hearts, or rather in the joy of their stomachs, were quite loud in their praises of the far-famed Ortolan, and all pronounced its flavor much superior to that of the poor unpretending Reedy of America. But before leaving the *café*, we must acknowledge there were some long faces and short purses in the "crowd," that seemed disposed to disparage the well-

merited compliments that were so lavishly bestowed upon the French Bird ; and several were even so ungrateful, after stowing away a whole brood of them in their stomachs, as to draw invidious comparisons between the two rivals for gustatory favor. After mature reflection, however, the whole party, one and all, declared in favor of the Reed-Bird of America, at twenty sous the dozen, over the French Bird at one dollar a piece.

“ As soon as the frost makes its appearance in Pennsylvania, the Reed-Bird, as well as the Rails, take their departure for the South, and it is seldom that we find either of them with us longer than October. After they leave our rivers, they continue their course South, visiting the rice-fields of the Carolinas and Georgia, and often commit great havoc in those regions.— Although thousands upon thousands of these birds have been destroyed in their route from the North, still, thousands upon thousands of them yet exist, and every gun is again brought into requisition in their new quarters, to thin down their inexhaustible numbers ; but all to no purpose, as they still continue their flight in immense bodies, as the winter advances, and ultimately arrive at the termination of their long voyage in the West India Islands. In Jamaica, they are called Butter-Birds ; and there, as in all other parts where they make their appearance, they are highly esteemed for the delicacy and richness of their flavor.

“ Audubon states that when these Birds migrate South in the autumn, their flight is diurnal, but when returning in the spring, they travel mostly at night. Such, however, has not been the result of our observations, as we have noticed the flight of Reed-Birds many, many times during the autumn, in the still hours of night ; and in the spring, we have also seen them travelling during the day.

“ Another interesting particular respecting the Reed-Bird is the singular change that takes place in the plumage of the male, which begins to change in June, and by the close of the following month has approached so nearly to that of the female, that it is very difficult to distinguish one from the other. This circumstance, in connection with the fact that the plumage of all the young birds also resembles that of the females, has given rise to the vulgar notion that the male birds never return from the North, but what becomes of them every one of course is unable to conjecture.

“ The plumage of the Reed-Bird is variegated and pretty, and he makes a very contented and happy captive for the Bird Fancier ; soon forgetting his former life of freedom, he resigns himself to his lot, and sings merrily and cheerfully for several months in the year. His notes are agreeable, and capable of much improvement by associating him with the Canary Bird, with which we have been told he will pair. The truth of this we cannot vouch for, however.

“ We were shewn, a few days since, a Reed-Bird, the plumage of which was a perfect Canary color ; and if we had not recognized the bird from its general outline, we should have pronounced it *an overgrown Canary*, so complete was the change that had taken place in its appearance.”

After spending the winter months in the West Indies, the Bob-link, at

the return of spring, impelled by the inscrutable instinct implanted in his nature by the Creator, commences his annual journey to the North, there to bring forth and watch over the young broods, and enliven the green fields with his song. About the 1st of May they reach the Northern and Western United States, and shortly after are spread all over Canada.

Sir John Richardson saw them on the plains of the Saskatchewan in latitude 54°, north. The breeding season over, they again return to the South, again destroy the fields of the planter, and are themselves destroyed.

The generic name is derived from the Greek, (*Dolichos*), long; and (*Onyx*), a claw, in allusion to the length of the claws. The specific name is from the Greek, (*Oryza*), rice; and the Latin verb, (*Voro*), to devour.

The following is Audubon's description of the genus, which contains only the one species:—

DOLICHONYX, (Swains.) RICE-BIRD.

“Bill rather short, very stout, moderately compressed, conical; upper mandible with the dorsal line straight, a little convex at the base, and very slightly deflected at the end, its ridge rather broad, indistinct, sides rounded, edges direct, overlapping, tip rather acute; lower mandible with the angle of moderate length, very broad, dorsal outline ascending slightly convex at the base, sides erect and convex, tip acute; gape-line ascending for a fourth of its length, then direct. Nostrils small, elliptical, operculate. Plumage blended, but firm, with little gloss. Wings rather long, pointed, the first quill longest. Tail of moderate length, the feathers narrow and acuminate. Toes large; claws very long, little arched, slender, tapering to a fine point.

“*Dolichonyx oryzivora*, LINN. Wandering Rice-bird. Bob-o-link.— Maybird. Ortolan.

“Male with the head, cheeks, lower parts, wings, and tail, black; a band of brownish-yellow across the hind neck; the back anteriorly black, the feathers with yellowish edges, posteriorly light grey, passing into white, of which colour are the scapulars. Female with the upper parts light yellowish-brown, longitudinally streaked with blackish-brown; the lower parts light greyish-yellow, the sides streaked with dusky. In autumn, the males assume the plumage of the female.

Male 7, 11.

Passes from Texas eastward and northward. Breeds from the Middle Districts northward. Extremely abundant. Migratory.

Rice-Bunting, *Emberiza oryziora*, WILS. Amer. Orn. v. ii. p. 48.

Icterus agripennis, BONAP. Syn. p. 53.

Dolichonyx oryzivorus, Sharp-tailed Rice-Bird, SWAINS. & RICH. F. Bor. Amer. v. ii. p. 278.

Rice-Bird, or Bob-o-link, NUTT. Man. v. i. p. 185.

Rice-Bird, *Icterus agripennis*, AUD. Orn. Biog. v. i. p. 283; v. v. p. 486.”

ARTICLE XXXVIII.—*Notice of the remains of a species of Seal, from the Post-pliocene deposit of the Ottawa River,—By Professor JOSEPH LEIDY, M. D.*

(From the Proceedings of the Academy of Natural Sciences, Philadelphia.)

“E. Billings, Esq., of Ottawa, West Canada, recently sent to the Academy, for the inspection of its members and for description, a specimen consisting of a slab or portion of a concretion of indurated clay, containing some imbedded bones, which Mr. B. observes, in a letter accompanying the specimen, ‘appear to him to be those of the extremities of a small animal of aquatic habit.’ Mr. B. further states, ‘the specimen was discovered by Mr. Peter McArthur, in a bed of blue clay containing boulders and marine shells and fishes. The locality is in the township of Gloucester, county of Carleton, Canada West, about nine miles east of the City of Ottawa. From this city the river Ottawa runs easterly for about sixty miles, in a channel excavated through a bed of the glacial drift, composed in some places of clay, and in others of sand, gravel and boulders. Where the specimen was discovered, the bank of the river is of clay about thirty feet high, at the time of low water. The water washes out of the bank numerous nodules of the clay, which are consolidated into a pretty hard kind of stone. Many of these nodules, when split open are found to contain shells, or the skeletons of fishes, often beautifully preserved. The species of shells found up to the present time are *Tellina groenlandica*, *Mytilus edulis*, *Saxicava rugosa*, and a small rostrated one like a *Leda*; and of fishes two species, *Mallotus villosus* and *Cyclopterus lumpus*. They also contain leaves of trees, broken wigs and grass, showing that there was land at no great distance. There is a ridge of low metamorphic hills on the north shore of the river, extending for a great distance parallel with and near the stream. On the south side the country is level, and underlaid with lower Silurian rock, Utica slate, Trenton, Black River, Bird’s-eye and Chazy limestones, with here and there a strip of the lower rocks brought up to the surface by undulations. I think there was an ancient valley excavated in those rocks before the period of the drift, that it was filled up during that period, and that the river is now cleaning it out again.’

The bones referred to prove, on examination, to be those of the greater portion of the hinder extremities of a young Seal, but whether of a species distinct from those now found living in the neighboring seas, is a question only to be determined by careful comparison with the corresponding parts of the recent animals. The soft distal extremities of the tibia and fibula are crushed together. The bones of the ankle and foot are well preserved, but the epiphyses of the latter are separated and only partially developed. The matrix in the vicinity of the bones, is marked by the impressions of the hairs and skin, which enveloped them.

“SIR W. E. LOGAN, in a report on the “Geological Survey of Canada,” (1850, ’51, p. 8.) refers the deposit in which the above described specimen was found, and similar deposits of the St. Lawrence and its tributaries, to the

post-tertiary period ; and he further observes, that in these deposits, “the remains of whales, seals, and two species of fishes, and many marine shells of those species still inhabiting the Gulf of St. Lawrence, are found ;” from which remarks, together with those of Mr. Billings, and the appearance of the fossil itself, we are inclined to suspect the Seal of the Ottawa has its descendants yet sporting on the sea border of the Canadas.

“Independent of all other considerations, the specimen is interesting, as exhibiting the same process at the present geological period, which for so many successive ages has preserved the remains of vegetables and animals, which are now examined by the palæontologist as so many iconographic illustrations of life in the history of our planet.

“Plate III. Representation, two-thirds the size of nature, of the greater portion of the bones of the hinder extremities of a young Seal, partially imbedded in one-half of concretion of indurated clay, from a post-pliocene deposit of the Ottawa River, Canada.”

MISCELLANEOUS — NOTICES OF BOOKS, &c.

Descriptions of some remains of Fishes from the Carboniferous and Devonian Formations of the United States, and also of some extinct Mammalia. By PROFESSOR JOSEPH LEIDY, M. D., Philadelphia.

We have received from the author, a copy of the above-named beautifully illustrated Memoir. Among the Mammalia, is described the skull of an extinct species of wolf discovered in the banks of the Ohio River, where it was associated with the remains of the Megalonyx Bison, Virginian Deer, the extinct Horse of America, (*Equus Americanus*), and the Tapir. Prof. Leidy says “The fragment, in comparison with the corresponding portion of the skull of the common wolf of Europe, and its American congeners, differs only in being larger, and in presenting slight variations in the teeth, not however greater than those found among different varieties, or perhaps even individuals of recent wolves.” He proposes for the fossil, the name, (*Canis primævus*). We should have noticed this discovery in our article on the wolf, but overlooked it.

Another specimen is a fragment of the lower jaw, and an upper molar tooth of an extinct Bear, (*Ursus amplidens*, Leidy,) which appears to have been intermediate in size between the Common Black Bear (*Ursus Americanus*), and the Grizzly Bear, (*Ursus ferox*.) It was found in a ravine in the neighbourhood of Natchez, Mississippi. In the same deposit were discovered the remains of the Mastodon, Megalonyx, Mylodon, and other creatures of long lost races. The Black Bear, the Virginian Deer, and the Buffalo, had made their appearance in America before these gigantic animals became extinct, their bones being found in the same association.

Another curious fossil described by the Professor, is the jaw of an animal of the Camel family, (*Camelops Kansanus*, Leidy,) found in the Kansas territory.

DR. ISAAC LEA has sent us a pamphlet in which he describes twenty-five new species of Uniones, chiefly from the waters of the far-off kingdom of Siam. The extraordinary genus (*Unio*), to which these shells belong, consists of a multitude of species distributed throughout all the fresh waters of the globe. In Lea's Synopsis of the Family of Naiades, published in 1852, there are mentioned 401 species in a recent state, 97 fossil and 84 others noticed by authors, whose descriptions appear to be doubtful. In addition to these there were then known a sufficient number of forms belonging to the closely allied genera of *Anodon*, *Margaritana*, &c., to make the total 767. Many species have been since contributed, and the number is now probably over 800. Among the 25 new species described, are 14 from Siam, 1 from Burmah, 2 from the Cape of Good Hope, 1 from Sina River in India, 1 from Brazil, 1 from River Macacou, Rio de Janiero, Brazil, New Grenada, 1 from Australia, 1 from Rio Plata, 1 from Mocha in Asia, 1 from River Amazon, 1 from Medellin River, Mexico. Of all the families of the Mollusca, none has excited more intense interest in the scientific world than the NAIADES, of which the clam shells of our Canadian rivers are examples.— Among them are many very beautiful shells, and of almost every form seen in the whole range of all the other species of bivalves. Some of them are very rare and eagerly sought after. The physiological structure of the animals has engaged a great deal of the attention of the best anatomists, while the systematic zoologist has encountered here several problems of no ordinary difficulty. In this, his favorite department of science, Dr. Lea is considered the leader in all parts of the world, and has published a number of beautifully illustrated works. The Pamphlet before us also contains a paper on the new Red Sandstone of Pennsylvania, and descriptions; a new sub-genus of Naiades; a new species of *Triquetra*, and some new fresh-water shells from California.

KIRBY & SPENCE'S ENTOMOLOGY.—Mr. Dawson of Montreal has a supply of the new and cheap English edition of this highly interesting work. Our young countrymen who desire to make themselves acquainted with the manifold wonders of the insect world would do well to provide themselves with this book. We look upon this work as of the same importance in Entomology that LYELL'S PRINCIPLES are in Geology. It contains a vast fund of information relating to the Metamorphoses, Food, Stratagems, Habitations, Societies, Motions, Instincts, &c. of Insects, without which no sound knowledge of this delightful science can be acquired unless by years of labour. The book contains over 600 closely printed pages, and is sold for only 7s. 6d.

THE WORKS OF AUDUBON.—We would strongly recommend that every Public Library in Canada should purchase a set of the Works of the great Ornithologist and Naturalist, AUDUBON. Those whose funds are not sufficiently abundant to afford the very expensive editions may, without much effort, procure those less costly. It is scarcely necessary to state, that a Library with any one of the editions must rank immeasurably above others not thus furnished. These works are for sale by C. S. Francis & Co. No. 252, Broadway, New York; and for the information of parties who may desire to purchase, we shall give their advertisement entire, as we find it in their Catalogue.