

lar establishment in the Province, the best opportunities have been afforded for a fair trial. The experiments have been carried out by Dr. Krackowizer, the manager of the mines, in conjunction with Prof. Lawson of Dalhousie College, whose laboratory investigations of the process were detailed sometime ago to the Institute of Natural Science. The results are highly satisfactory, and fully confirm the favourable opinion that has been formed of Crooke's process, and of its adaptability to Nova Scotian ores. One great advantage of the process is the action of the sodium amalgam upon pyrites, which material abounds in our quartz veins and is known to contain gold, but has hitherto been accumulating around the mines in enormous quantities as a waste material. A portion of this material operated upon by the new process gave at the rate of 5 ounces of gold per ton of pyrites. This is regarded as a remarkable result, and one that will certainly lead to the profitable extraction of gold from pyrites, especially as no extra apparatus is needed such as would be necessary for the chlorine process."

NO. X. ON THE FOOD FISHES OF NOVA SCOTIA. NO. IV. THE TROUTS AND SALMONS. BY J. BERNARD GILPIN, A. B., M. D., M. R. C. S.,

[Read April 2, 1866.]

I HAVE identified five species of the genus *Salmo*, as inhabiting the fresh and sea waters of this Province. They all closely resemble each other, in their powerful tail, and strong muscular back, their armature of numerous and recurved teeth, their tendency in the young to vertical markings, and the most of them to spots,—by all having the false or internal opercle as noticed by Muller,—by all spawning in November,—and all requiring highly ærated water in which to deposit their ova, thus seeking shallow streams of swift running water,—by hunting for their food singly, or in small numbers,—by a common voracity, and boldness, all with one exception having the power of throwing themselves several feet above the surface of the water,—by all seemingly enjoying life, and parting with it by fierce struggles—this last making them game-fish,—and lastly, by all of them being marked by a fatty fin, without rays, a typical mark whose use we cannot explain, and which they share with the very kindred geni of *Corregonus*, and *Thymallus*.

In identifying *S. Salar*, (Lin.), *S. Fontinalis*, (Mitch.), *S. Canadensis*, (Ham. Smith), *S. Gloverii*, (Girard), *S. Confinis*, (DeKay), and attributing them to their rightful first describers, I have met with much difficulty. The principal writers seem to have had no personal knowledge themselves of the fish in question, whilst the best observers seem to have wanted what the first gentleman had, a scientific tact and skill of observation. Thus Perley, followed by Frank Forrester, has confounded *S. Canadensis* with *S. Trutta* of Europe, and *S. Gloverii* and *S. Confinis*, with *S. Ferox*, also European. I need scarcely say how soon Yarrel, or "Couch's British Fishes" would correct this error. In the present paper I have only given facts that I have identified myself, or that have been told me by local observers. The works I have referred to are those of Richardson, DeKay, Storer, Gill, Norris, Frank Forrester, "*Game Fish of the North*," Perley, and manuscript correspondence of F.W. Putnam, Esq., Salem, U. S.

Salmo Salar—THE SALMON.

The description of a fresh run fish from the ocean, as they appear in spring in our market, would be — weight from six pounds up to twenty, head small, body very deep, and at the same time round or thick through; back very muscular, and tail large and strongly based; the opercle is circular on its outside edge, in this a very marked contrast with the trout, in which it is angular; the free edge of the labial is rounded, whilst the same part in the trout is sharp; the eye rather small and about two and a half diameters from tip of nose; the nostril double, like all the genus; the outline of back rounds up from the head, then runs in nearly a straight line to the first dorsal, which has twelve rays, the first very thick and short, and of an irregular rhomboidal shape; the anterior edge of the second dorsal or adipose fin is opposite the fifth ray of the anal, its posterior edge opposite the last ray; the tail very strong, rays twenty, the anal ten, first very thick, and ventral nine, the pectoral fin rises close to the margin of opercle; the colour fresh from the sea is black along the back, running gradually into steel blue, with green reflections to the line of raised scales, all below of the brightest silver; the head and opercles are, upper half dark blue, lower silvery; the fins, dorsal pale lavender with irregular spots, rays dark blue, adipose blue, caudal base and edges dark, middle pale yellowish white, anal pale yellow; ventral with large accessory fins yellowish; rays and anterior edge dark, pectoral pale bluish white, anterior edge and rays dark blue; on the pre-opercle and opercle are one or two black irregular spots; a number of black blotches occur at irregular intervals along the sides and side of the belly. Teeth on intermaxillary, upper and lower maxillary, palatine bones, in vomer, but not more than two or three, and on tongue about nine or ten around the edges; scales very large. Fin rays—D. 12, V. 9, P. 11, A. 9, C. 20, a large axillary scale to V. Gill rays—11 on each side. Posterior edge of opercle round, free end of maxillary round.

Such is a description of this king of fish, as he appears from the ocean. But it gives but a faint conception of the flashing lights thrown back from his sides of molten silver, upon the tender blue of his back, or of the dying but fair lavender of his fins. Filled with the only food upon which he thrives, the ova of various echinodermata, or the flesh of the sand eels, his huge back is swelled out and rounded like a race horse. The flesh itself is tinted red, and fat flakes lie thick in the fibres of every muscle. His courage and strength are equal to his form and colour,—and he has need of them all. A long and weary journey is before him, with scant food and hard toil. He enters our rivers, beginning in March at the most southerly and westward ones, to ascend the lakes to his spawning grounds. Towards the end of June the run at Halifax is over. He buries himself now in our lakes, and for a time nothing is seen of him. On his passage up he takes the fly, and is seen leaping over the natural obstacles or artificial barriers that arrest his progress. From six to eight feet is his utmost perpendicular height. He is often seen lingering in the deep holes of the streams which he is ascending. He becomes lean and thin almost immediately on entering the fresh waters. His flesh loses the lively red tint and exquisite flavor, his silvery sides turn yellow, and his steel blue back a dingy black, reddish diffused patches stain his sides and head and cheek. In the male, changes much more characteristic are stealing over him, the upper jaw lengthens, teeth both more numerous and larger appear; an eagle-like hook is formed; the lower jaw lengthens, curves up, is armed with supplementary teeth, and a nob or hook of gelatinous substance sprouts out of its end, which fits into a hollow of the upper jaw.

On the 10th July, 1865, I noticed many large salmon taken from the fresh water river, Shubenacadie. They had been some time in fresh water, had lost their blue and silver hue, and pink flesh tint, and had also lost their teeth, some of them almost entirely, others partially. Their jaws were arched, the bone evidently absorbed. I was much puzzled to account for so many old fish being taken at once, and only in fresh water, since such fish were never known from the sea. On the 26th November, 1865, M. Brown, Esq., Halifax, sent me a salmon, a male fish, weighing perhaps sixteen pounds, whose head and jaws were so peculiar as to need an exact

description. The intermaxillary articulation was very loose and much enlarged. The intermaxillary bone itself had grown at least two inches in length, formed into a beak like an eagle's, and filled with very large teeth. The lower jaw had also grown to correspond in length, and was also armed with large teeth. A cartilaginous knob projected upwards from the lip, which fitted into a groove above in the intermaxillaries. The new jaws were so arched that it was impossible for them to close in the centre, and the teeth were much larger and with wider bases than the usual teeth. I am now of the opinion that the toothless fish I saw in July were preparing, by losing their original teeth, for this spawning growth, soon to sprout from their denuded jaws, of not only increased osseous matter, but of an entirely new set of teeth, and that the whole of the huge structure in a few months, broken down or worn away by conflicts and by furrowing up the sand and gravel, becomes totally absorbed on reaching the ocean, and is again replaced by the ordinary teeth, thus each male salmon having two sets of teeth during the year.

Towards the latter part of November he is seen frequenting the shallow, sandy bottomed running streams. He is busy furrowing up the gravelly bottom with his lower jaw, in water so shallow that his tail flaps upon the surface. The loitering sportsman often overlook him working up stream so as not to foul his water, and sedulously conducting his mate into the furrow where he impregnates the ova streaming from her teeming sides, or rushing out upon the shoals of young males in clouds about him, each a miniature salmon with hook and bill, though barely six or seven inches long.* The lumberman too is sometimes tempted from his toil by suddenly coming upon a shallow lake literally covered by hundreds if not thousands.† Serious encounters are sometimes instanced between two rival males, the wounds taken and given are often frightful. At the end of the season, an old male thoroughly emaciated, lean, dingy yellow, his jaws literally worn to the bone or hanging in fragments, his body torn into gaping wounds, with his pale blue gleaming eyes, is truly a ghastly form, flitting dark and dull and

*Charles Anderson, Esq., Magistrate, Musquodoboit.

†Mr. John Duncan, Ingraham River, told me that he once with a party of lumbermen, came upon at least a thousand salmon, spawning upon Snake Lake, Halifax County. For every man and teamster to desert his work, and rush into the shallow waters, with axe, or pole, or ox goad, or young sapling, was the work of an instant. Some eight or ten were the only spoils that rewarded their cupidity.

half seen through his watery home. They are now said to return to the sea, principally because we find them there in early spring. This part of his return journey has not so many landmarks about it as I could wish. Indeed some say they remain all winter in the lakes, and no doubt many do. Thus it may be said that the salmon in Nova Scotia have their principal run from the ocean to the lakes in April, May and June—that they spawn in November and immediately return. But this is only generally true. From a number of facts I am led to conclude there is a perpetual passing up and down during the whole summer. On the 20th of May, 1865, I procured from the tide way at Bedford Bridge, five young salmon from six to eight inches long, these I suppose were fry of the last year, fifteen or sixteen months old, going to the sea for the first time. With the exception of a few vermilion spots upon them, and that the nose was rounded and short, they were true salmon, teeth perfect and some with ova. It is now admitted (from the numerous and conclusive experiments of marking fish) that they visit the ocean and return in a few weeks weighing six to seven pounds, and spawn in November. Successive runs of these fish must be perpetually passing up and down our rivers. In September, female spawning fish, entirely discoloured, and filled with spawn of the size of buck shot, which escapes readily, are exposed in market from the Shubenacadie river, and one would never think they could retain their spawn till November. The year just past was unusually dry and the lakes and streams low. Thus Bedford river, near Halifax, was thronged with fish unable to get up. In November thirty were counted from Flat rock in one deep hole. Our markets have always a run of November salmon taken outside on the ocean, in the highest condition, and which according to Col. Hardy, have the ova very small and undeveloped. Thus at one point of time we have three sets of fish, one spawning or spawned in the lakes, one running up, and a third ranging the ocean unimpregnated. From these facts we must deduce that there are modifications perpetually occurring to vary within certain limits any general law. On his passage he readily takes the fly, during his sojourn in the lakes not; though of these facts I am not quite certain. In the ocean we find him a deep feeder, his food being said to be the spawn of various fish, and he is often taken by bait fishing on our coast some distance from shore, and at about sixty

or seventy fathoms. There can be little doubt that he also feeds upon smaller living fishes as well as flies and larva.

One must witness a score or two of these fine fish for sale in the Halifax fish market dripping fresh from the ocean, before they can truly appreciate their magnificent proportions, their great depth and thickness, and great round backs swelling into so massive a foundation for their huge tails,—the clear silver laced with blue of the sides, the opal tints flickering around their bellies, or the fleeting lavender of their fast stiffening fins. Those figured by Yarrell and Couch, by Dekay, and even Agassiz, a Halifax fisherman would not allow upon his stall. The extreme length and want of depth would condemn it at once as a spent fish. Of the many stories of marvellous captures of these fish, the best and certainly the truest is the following, which happened in my own time and neighborhood:—Mr. Baillie, grandson of the “Old Frontier Missionary,” was fishing the “General Bridge river” up stream for trout, standing above his knees in water with an old negro named Peter Prince at his elbow. In the very act of casting a trout fly, he saw, as is very usual for them, a large salmon lingering in a deep hole a few yards from him. The sun favored him, throwing his shadow behind. To remain motionless, to pull out a spare hook and pen knife, and with a bit of his old hat, and some of the grey old negro’s wool to make a salmon fly, then and there, he and the negro standing in the running stream like statues, and presently to land a fine salmon was the work of but a few moments. This fly must have been the original of Norris’s killing “silver gray.”

Salmo Fontinalis—MITCHELL—BROOK TROUT.

The description of this fish as usually seen in the lakes about Halifax, would be—in length from ten to eighteen inches, and weight from half a pound to two pounds—though these measurements are often exceeded or lessened. The outline of back starting from a rather round and blunt nose rises gradually to the insertion of the dorsal fin, about two lengths of the head from the nose; it then gradually declines to the adipose fin, about a length and a half from that runs straight to form a strong base for the tail. The breadth of the tail is about equal to the length of the head. Below, the outline runs nearly straight from the tail to the anal fin, from thence it falls rapidly to form a line more or less convex (as the fish is in or out of season), and returns to the head. The intermaxillary very short, the maxillary long with the free end sharp pointed. the posterior end of the opercle is more angular than in the the *S. Salar*, the lower jaw shorter than upper when closed,—appearing longer when open.

The eye large, about two diameters from tip of nose; nostrils double, nearer the snout than the eye. Of the fins, the dorsal has ten or eleven rays, not counting the rudimentary ones, in shape irregularly rhomboid but the free edge rounded or curved outward, the adipose fin varies, some sickle shaped with free end very long, others having it very straight and short. The caudal fin gently curved rather than cleft, but differing in individuals. Of the lower fins, they all have the first ray very thick and flat, and always faced white with a black edge, the other rays more or less red. The head is blunt and back rounded when looked down upon. The teeth are upon the intermaxillary bone, maxillary bones, the palatine, and about nine on the tongue. There are none so called vomerine teeth, though now and then we find one tooth behind the arch of the palate, where they are sometimes irregularly bunched together. The colour varies but through all the variations there are forms of colour that always persistent must be regarded as typical. There are always vermilion spots on the sides, there are always other spots, sometimes decided in outline, in others diffused into dapples—but always present. The caudal and dorsal fins are always spotted and of the prevailing hue of the body. The lower fins have always broad white edges lined with black and colored, with some modification of red. The chin and upper part of the belly is always white. With these permanent markings, the body colour varies from horn colour, greenish, grey, blue grey running into azure, black, and black with warm red on the lower parts, dark green with bright yellow lower parts, and lastly in young fish, vertical bands of dusky black. The spots are very bright and distinct when in high condition or spawning, faint, diffused and running into dapples when in poor condition. Of four trout purchased from a negro woman at Halifax, Oct. 28, 1864, during the spawning season, three were dark green, bright yellow spots, bright yellow bellies, dorsal fin spotted black on yellow ground, caudal spotted black on scarlet ground; lower fins scarlet with white facings lined with black. The fourth was nearly black above washed with red, the red becoming exceedingly vivid on the belly, all the fins bright scarlet marked as the others, spots bright scarlet—all had white chins, and stripe on the belly white, spots in all very small and vermilion specs in all, all the hues were most vivid and heightened by profuse nacre. This may be considered the colour in the highest condition. In others, the spots are very pale yellowish white and running on the back into vermicular lines, the irides in all dark brown. I have seen the rose or red coloured ones at all times of the year. The young of the first year are green horn colour, with brown vertical stripes and bright scarlet fins, and tail already showing the typical markings and spots, and also the vermilion specs. Fin rays D. 13, P. 13, V. 8, A. 10, Gill rays, 12. Scales very small; dorsal has two rudimentary rays, ten or eleven long ones, varying in different fish. Typical marks, axillary plate nearly obsolete—free end of maxillary sharp, bars in young, vermilion specs, both young and adult lower fins red with white and black edge.

Unlike the salmon who is always a stranger, this beautiful fish is a favorite with all. He is with us the whole year, in large lakes, in brooks, in tiny rills where the young lurk for security, and even in the tide waters, to which he will always resort if in his power. In June, 1866, I saw some of exceeding beauty and colouring taken from the tide waters of Digby basin. At the outlet or inlet of some

still water is his favorite resort, where poised on ever fanning fin he awaits his food. Whoever has had the privilege of lying at full length on a mossy bank and watching him in his lair—an old root or a tiny cave washed from the overhanging clay banks of the swift running waters, will agree with Agassiz*—“that a true figure of him has yet to be done.” Head elevated at a slight angle, his capacious gills opening and closing, round mouth half open, and great round head and speckled and spotted back, overhung by the spotted dorsal hanging athwart, and throwing wavy circles off from every point, his gaudy scarlet tail and lower fins all tremulous, there he awaits his prey, be it an idle fly touching the surface, a larva coming down stream, or a venturesome young perch. No spotted pard makes a fiercer rush than this marine tiger, on his quarry. The perch, if he is an eider (coming towards him), disappears at once, or the fly is snapped with an unerring precision. The true figure which yet has to be drawn must make him with a luminous brown eye, round in head and back, the dorsal hanging loose across his back and half elevated and floating watery circles from every point. The pectoral and ventral extended in parallel lines at nearly a right angle from the body and ever fanning—a double pair of propellers, the anal trembling through all its line, and the huge tail vibrating, every ray loose and every membrane floating. The ordinary plates make every fin stretched and rigid, and the pectoral always thrown back upon the side. In October and November he leaves the deep waters for the spawning shallows. In winter he is taken by bait through the ice. Of his muscular power in running up rapids, Dr. Fisk, of St. John, N. B., an accomplished sportsman, informed me that once fishing the upper waters of the Miramichi he saw trout repeatedly rush up a perpendicular fall of water about six feet, then pause, tremble violently all over, and in a moment throw themselves clear of the stream and fall into the basin above, about four more feet. Many assert this is done by bringing head and tail together, but in the simple terms of an eye witness, a “trembling” was all he could perceive, which no doubt was all that was to be observed.

Six pounds is the largest weight of any trout taken in this Province to my knowledge, two and three pound fish always attract attention. I have never seen one myself four pounds. The colour

*Fishes of Lake Superior, 1850

of his flesh varies from red to pink, and pale yellowish white. Inferior in taste to salmon, it is only prized by those who cannot get the sea-board fish, yet it tastes very savoury roasted and eaten ten minutes after swimming in the cool waters, from a sharp pointed stick stuck around a camp-fire.

Salmo Canadensis—HAMILTON SMITH.

In early spring there is taken by gill nets or by fly fishing about Halifax, a sea trout. The tide water mouths of the various rivers are its favorite resort. In these waters he remains till August, sometimes running up the rivers with the tide a few miles, then again running sea-ward. A very gaudy fly will tempt him out of cover, in the thick tangled kelpy marine forests. Again he is found lurking in the up river deep holes of our turbulent streams. After August he is never found. This is the *Trutta* of Perley and Frank Forrester, confounding it with the English species. This is the salmon trout of "*The Game Fish of the North*," whose author identifies it with *S. Fontinalis*; and also this is the *S. Canadensis* of Hamilton Smith, in Griffith's Cuvier, as given in Dekay and Norris's *American Angler*. The question has been still more complicated by the brook trout running to sea, which they are always fond of, and thus being classed as sea trout.

On 26th May, 1864, Mr. John Butler, Bedford Hotel, gave me two taken from tide water. June 18th, J. Willis, Esq., gave me one from Cole Harbour, and during July I examined some dozen from Musquodoboit, and finally Wm. Silver, Esq., Halifax, gave me one in Sept. from the fresh water, the rest were from the tide water.

The description of these fish would be thus: of those from the tide way, length from twelve to fourteen inches, deepest breadth, something more than one quarter from tip of nose to insertion of tail. The outline rounds up rather suddenly from a small and arched head to insertion of dorsal, slopes quickly but gently to adipose fin, then runs straight to insertion of caudal, tail gently curved rather than cleft, lower line straight to anal, then falling rather rapidly to make a very convex line for belly and ending at the gills. The body deeper and more compressed than the brook trout. The dorsal is quadrangular, the

NOTE.—Wm. C. Silver, Esq., gave me a trout Sept. 29, 1866, taken on his own grounds, weighing about two pounds, fifteen and a half inches long, entire depth five and a half inches. This was a male fish, milt well developed. The intermaxillary enlarged and armed with larger teeth having a notch in it to receive the lower jaw, also lengthened and hooked. These changes altered the profile of the fish giving him a pointed nose. The colour was most brilliant, the belly tints carmine and the sides of the tenderest azure. The lower fins and lower edge of tail had the broad white and black anterior rays very well developed.

free edge convex, the lower fins having the first rays in each thicker and flatter like the brook trout. The adipose fin varies, some with very long and arched free end, in others small and straight. The specimen from the fresh water was very much longer and thinner, and head proportionally larger. The colour of those from the tideway was more or less dark greenish blue on back shading to ash blue and white below, lips edged with dusky. They all had faint cream coloured spots, both above and below the lateral line, with one exception they all had vermilion specks, but some only one of a side, others two or three. The head in all greenish horn colour. The colour of the fins in pectoral, ventral and anal, varied from pale white, blueish white to pale orange, with a dusky streak on different individuals. Dorsal dusky with faint spots, and caudal with dusky tips, on some a little orange wash. The lower fins had the first ray flat and white and edged with dusky. In two specimens the entire fish was spotted with minute black spots on every part, save the fins where the spots were red, but I considered these to be diseased fish. I leave it to better pens than my own to describe the glorious colouring of this fish dripping from the ocean. The fair green vying with the tender blue of the head and back, the silver of the sides, the lovely pink flesh showing through the silver of the belly, and the catching reflections crossing everywhere. In the specimen taken 10th Sept. from the fresh water, the blue and silver had disappeared, and dingy ash colour had spread down below the lateral line; the greenish horn colour had spread itself over the whole gills except the chin, which was white. The silvery reflections were all gone, the cream coloured dapples were much more decided in colour and shape, and the vermilion specks very numerous. The fins, the caudal and all the lower fins had an orange wash, the dorsal dusky yellow with black spots, the lower fins retaining the white flat ray with a dusky edging—and the caudal a few spots.

The teeth of all were upon the intermaxillary, maxillaries, palatine and on the tongue, none on vomer except now and then one tooth behind the arch of palate.

Fin rays, D. 13, P. 13, V. 8, A. 10. Gill rays 12. Axillary scale very small. Dorsal with two rudimentary rays, ten or eleven long ones, free edge convex, first ray lower fins flat, scales very small but rather larger than brook trout.

The weight of this fish goes as high as seven pounds, their general average is about two pounds. The flavor of their flesh exceeds salmon when fresh, salted or pickled it is very dry. I have said before that from May till August he is taken in our tide waters, both in the Bay of Fundy and along our Atlantic sea board and at Cape Breton. After August he is found in the lakes and streams. C. Anderson, Esq., magistrate, informs me he has taken them during winter through the ice by bait, from one to twenty miles from the salt water, and that he has often seen them returning to the sea in March. Mr. John Duncan, St. Margaret's Bay, is of the same opinion. Wm. C. Silver, Esq., of Halifax, who has studied their habits for years, and in waters running through his own lands, and almost past his

own door, is of opinion that they remain all winter in the fresh water, leaving the tideway in August, that they rapidly change their colour and shape in fresh water, approximate to the brook trout in both, but are always distinguishable.

In classing this fish we must acknowledge it exceedingly closely allied to *Fontinalis*, that it has the teeth, shape of fins, axillary plate, tail, dapples, vermilion specks, spotted dorsal, alike; that when it runs to fresh water, it changes its colour, and in doing this approximates to its red fin and dingy green, and more numerous vermilion specks still more closely. Whilst on the other hand, we find it living apart from *Fontinalis*, pursuing its own laws, attaining a greater size, and returning year after year to the sea. That *Fontinalis* is often found unchanged under the same circumstances. That it always preserves its more arched head, deeper and more compressed body, and perhaps shorter fins. That this has been so for certainly a hundred years, and most probably for thousands, nor have we any evidence that it was at any time not so, except by analogy. In giving it a specific name therefore, and using the appropriate one given it by Col. Hamilton Smith, so far as I can discover, the first describer, I think I will be borne out by all naturalists.

Salmo Gloverii—GIRARD.

Under the misnomer of *Grayling*, a very handsome dark brown trout has long been known to sportsmen as being killed in the lakes about Halifax. The largest were about seventeen to twenty inches long, and weighed two to four pounds. But it was more celebrated for its courage and game qualities, one of half-pound weight giving better sport than a salmon of six or eight pounds; they are often known to spring six feet out of water, three or four times in succession, when struck; they are taken by bait also, being greedy feeders. That they approach the shallow water, and spawn in November, and at other seasons, may be taken the whole year in the deep waters, being lake trout,—and that their young are taken during summer, in the margins of our lakes, having the red spots and tendency to

NOTE.—*S. Imaculata*, of Storer, with large scales, very large axillary plate, larger pre-opercle, is not to be confounded with this species. It is a more Northern species, and not taken in our waters. The dorsal is concave instead of convex. I have examined hundreds, but they were all pickled and from Labrador. The very large ones had no spots of vermil, but the smaller ones all had. In other respects Storer is correct. His description is based on one specimen.

vertical bars of the *Genus Salmo*,—is all that I have obtained of its habits. Their flesh is deep yellow in some cases, in others white and of no great flavor. I am indebted to F. W. Putnam, Esq., Salem, for directing my attention to a description of this fish by Girard, in the proceedings of the Philadelphia Institute Natural Sciences, May, 1854, the only notice I believe extant, and thus preventing me noticing it as an undescribed species. I here beg to acknowledge his courtesy as well as the scientific knowledge so kindly given to an entire stranger. The following description is taken from specimens given me by Lt. Col. Hardy, the late Archdeacon Willis, and Canon Gilpin.

Length, about seventeen inches; breadth of widest part from first dorsal, two and a half inches; length of head, nearly two and a half inches; the shape of head fine and small, the back rising rather suddenly, from posterior to head, sloping very gradually upward to insertion of dorsal, thence downward to insertion of tail, lower line corresponding with line of back; a long elegant shaped fish with a strong base to a powerful tail; eye large nearly half an inch in diameter and two diameters from end of nose; opercles rounded, and with the pre-opercles marked with numerous concentric streaks; the lower line of inter-opercle parallel with line of the body, labials both upper and lower arched, line of pre-opercle not so rounded as opercle; the pectoral fins coming out very far forward almost touching the gill rays, dorsal commencing about two lengths of head from tip of nose, sub-quadrangular, free edge concave, ventral about opposite sixth ray of dorsal, adipose fin opposite posterior edge of anal, and caudal deeply cleft, and very nearly the length of head in depth. In one instance the tail was square, intermaxillaries, maxillaries, palatines, vomer and tongue armed with sharp and recurved teeth, the teeth on the vomer extending half an inch down the roof of mouth, a fleshy line extending from them to the gullet, the upper jaw notched to receive the lower. In two specimens a prolonged hook in lower jaw advancing beyond the teeth. Girard says the male fish has adipose fins opposite anterior edge of anal, the female opposite posterior edge. Whilst in the following description taken from a female fish I have verified his remarks, I have added, in the male the adipose fin is very much larger, which is almost the same thing. Colour black above shading down to sepia brown at the lateral line, the brown being the back ground to numerous black spots, some round, some lunated extending from opercles to tail. The opercles partake of the same general colour with yellow reflections and blue tints, but also marked with spots extending to the pre-opercles, beautifully round and distinct; sides yellowish and belly white with pearly tints, the whole covered with bright scales larger about the sides than beneath. The colours vary much by the reflected lights made by turning the fish. The colour of the fins fresh out of water, caudal brown, dorsal brownish black and spotted, lower fins dark brown, edges and tips dark, a very fleeting lavender wash on dorsal, sides yellowish. In one adult specimen I noticed a few red spots on sides, but in the young fish they are very marked and beautiful. Some seen by myself in July had vertical bars, red spots, were very silvery on sides and all even the smallest had the typical opercular spots very distinct.

They were exceedingly beautiful and might have readily been taken for a different species. On opening the fish, from gills to tail the heart with its single auricle and ventricle first presented, the liver overlapping the stomach and pale yellow, the stomach descended about one-half the length of the fish, was then reflected suddenly upon itself where it was covered by numerous *cæca* (about thirty), these are the *pyloric cæca* of authors. It then turned down again and soon was lost in small intestine ending at the vent. The spawn were each of the size of currants and bright scarlet, about a thousand in number, and encased in a very thin bilobular ovary, the left lobe occupying the left side, being a little over three inches, and only one-half the length of right lobe occupying right side; a second fish gave the same placing of ovary. Both these fish were taken on the 2nd and 4th November at Grand Lake, Halifax, and evidently near spawning. Fins, D. 12 or 13, P. 14, V. 9, A. 9, C. 20. Axillary scale small. The first dorsal ray in some instances contains two in others three small rays. Typical marks, spots on opercles.

The Loch Lomond trout near St. John, N. B. are identical with these fish; I saw some at Stubb's Hotel, taken by H. Gilbert, Esq.; Perley confounds them with *S. Ferox*. With the exception of Girard I believe this species has not been noticed by naturalists or sportsmen, yet it is worthy of notice from both, by one for its game qualities, and by the other for its most resembling the European trout, in its teeth down the vomer and brown colouring and spots.

Salmo Confinis—DEKAY. *Salmo Adirondicus*—NORRIS.

For some years reports have been made of a large black fish seen in our interior lakes, principally from Chester. They were generally considered spent salmon. One gentleman about twenty years ago, built a boat, and camped for some time on the lakes, but was not successful. About two years ago Col. Sinclair sent two specimens to J. M. Jones, Esq., who identified them as the lesser lake trout, the *Salmo Confinis* of Dekay, common to most of the small lakes of the Northern States. Subsequently Col. Chearnley sent some to town taken by the Indians. From these and other specimens taken from great Pock Wock lake near Halifax, the following description is taken. The first, of one weighing about three pounds, and evidently a young fish.

Length eighteen and a half inches. Length of head one fourth of length to insertion of tail. In some others the head was rather longer. Insertion of first dorsal two lengths of head from tip of nose. The outline commencing from a round obtuse snout, rose almost immediately and suddenly, owing to the large orbit of a very large eye placed very high in the head, and ran gently upward to insertion of dorsal, then straight to adipose fin, then rather suddenly depressed to insertion of a very strong and deeply curved rather than forked tail. The outline of belly much more convex than that of back. The greatest

girth in front of dorsal and about one-quarter of length to insertion of tail. The labials arched, the eye very prominent and set high in the head, about two diameters from tip of nose, not quite four to outer edge of opercle, pre-opercle very thick and puffy, its outline at right angles with line of body, and subcircular. Interior edge of inter-opercle parallel with line of body. Colour fresh from water, black on back running to dusky below lateral line, where it assumes a yellowish wash and ending in white on the belly (one was mottled or obscurely spotted with white on sides, another had vertical bars of dusky). Head of the same colour as body, a little bronze on opercle and pre-opercle, tip and edges of chin blackish and below white. The dusky hue was caused by minute dots, the dots taking the form of scales on the belly. The colour of fins was—dorsal dusky yellow, spotted with three irregular rows of spots, rays lighter than webs, adipose blackish, pectoral and ventral yellowish dusky, when folded tips dark, a slight orange wash on tips, anal and caudal yellowish dusky, a slight orange wash on tips in anal. Teeth on palatines, vomer, upper and lower maxillaries, intermaxillaries and tongue, in one a few teeth down the centre of tongue as well as on the sides, upper lip notched to receive lower. D. 10, P. 14, V. 9, A. 8. Gill rays, 12. The first dorsal ray very thick, containing perhaps a rudimentary ray, the first rays of all the lower fins flat and thick, caudal cleft about one-half a length but outline rounded. Irides salmon yellow, scales minute, typical marks very large head, one-fourth length, fleshy pre-opercle and teeth down the middle of tongue.

These young fish resembled in outline, the plate of *S. Siscowitz* (Agassiz), the fins differing. They also resembled Norris's figure (*American Angler*) of *S. Adirondacus*, but in comparing them with other specimens weighing from seven to ten pounds, I found these last coincided with Dekay's figure, except that it is feebly drawn and not giving the strong characteristics of the adult fish, and that both, although the young fish was slender and elongated, and the older thick and stout, preserve the strong typical marks of the species. The large eyes set high in the head, and projecting orbit, the very fleshy pre-opercle, the short distance between posterior end of anal and caudal fins, the same colour and teeth, both having the very peculiar triple row on tongue, and the very large head. As the fish becomes larger all these typical marks become stronger, till one weighing twenty pounds or upwards, in his huge and fleshy jaws, thick back and tail and great girth, resembles more a cod than a salmon. Of the half dozen I examined, one, evidently an old fish, had an irregularity of caudal fins, the lower lobe much the longer. I attributed it to an injury, but Col. Hardy noticed the same irregularity, and Mr. T. Mackie, who has fished numbers of them, assured me it was quite common. I have no explanation for these facts. As regards colour, when taken immediately out of the water, the

heads are a dark greenish horn colour, the backs black, sides yellowish with spots and belly white. These colours are varied and heightened by the thick nacre and reflected lights of the scales. As the fish becomes stale, the nacre dries, and a light purplish or amethystine colour pervades the whole. The tip of caudal and lower fins faint orange or yellowish. *The third row of teeth* on the tongue so peculiar to this salmon alone, is not always to be found, even some adult fish have it not. Dekay and Perley give them, Frank Forrester not, yet each from actual inspection. I have examined specimens both with and without them. They are taken with a whole line, as fishermen call thirty fathoms. Our alpine lake basins having this great depth. The flesh is coarse. They are usually bottom feeders, though the Indians assert they will rise to a red rag, and perhaps never exceed twenty-two pounds, although there are many accounts of their huge size attained in lakes where there are no weighing scales.

In concluding, all what I could procure either personally or from reliable sources of this very interesting genus, a very few general remarks will suffice. In regard to teeth, we find as typical marks they are not so reliable as in the *Mammalia*. It is all but certain that *S. Salar* renews his teeth in the male twice a year. One species has a triple row on the tongue, and that not constant, the others having a double row. As regards vomerine teeth or rather teeth down the roof of the mouth, two, *Fontinalis* and *Canadensis* have none, or at best one tooth and that not constant, the *Salar* has two or three, and *Gloverii* and *Confinis* a strong row. I say teeth down the roof of mouth, for strictly speaking they all have vomerine teeth, for the palatine bones being each side of an arch of which the vomer is the keystone, and the palatine teeth being an uninterrupted circle round the arch, it follows that the head of the vomer always has teeth but not always down the bone. The author of that very pleasant book, "*Game Fish of the North*," should remember this when he asserts that *Fontinalis* has no vomerine teeth. When he indulges in sneers against naturalists, and smart writing about marine dentists, he should at least be correct, especially as only a scholar, a naturalist and sportsman combined, could have written as he has done of rock and flood. We have one species common to both worlds, another *Fontinalis*, in its teeth, red spots, rose belly, and

broad plated white edged orange fins, is the true analogue to the *Char* of Europe. Whilst *Gloverii*, in its brown colour and teeth resembles *Fario* of Europe and *Confinis*, the great lake trout of Scotland's lakes. So far I have never heard of *Corregonus* the analogue to the *Vendace* of England, but may find it at any time; not so with the splendored analogue to the *Grayling* of Europe, the *Signifer* of Sir John Richardson. His range is too northern, and his great beauty and typical dorsal would have betrayed his whereabouts long since.

ART. XI. THE GLACIAL PERIOD IN NORTH AMERICA. BY
THOMAS BELT, F. G. S.

[Read May 8, 1866.]

I. INTRODUCTION. II. GLACIATED ROCKS AND DRIFT-BEDS OF NOVA SCOTIA. 1. *Eroded valleys and scratched rocks.* 2. *Drift-beds.* 3. *Gold in the Drift.* 4. *Marine beds of the St. Lawrence.* III. ORIGIN OF THE GLACIAL PERIOD. 1. *Theories of Origin.* 2. *Recent changes of level of the land in northern hemisphere greatest towards the pole.* 3. *Effect of shutting off warm currents from the Polar Basin.* IV. ACTION OF THE ICE. 1. *Statement of the question.* 2. *Accumulation of the Ice.* 3. *Culmination.* 4. *Retreat.* V. APPLICATION OF THE THEORY TO SOME OF THE PHENOMENA OF THE DRIFT. 1. *Local character of the Drift.* 2. *Transported Blocks of Berkshire, Massachusetts.* 3. *Drift of the St. Lawrence. Terraces and Stratified Deposits.* VI. CONCLUSION.

I.—INTRODUCTION.

UNTIL the last few years most geologists have taught that the glacial period was one of a great submergence of northern land, over which floated icebergs bearing from more arctic regions, stones, gravel and clay. Agassiz had long ago argued that land and not floating ice had been the effective agent in the glaciation of countries, but his theory met with little support, until the investigations of Norwegian and Swedish geologists proved that the glaciation of the Scandinavian peninsula had radiated from the central mountains, and could not have been produced by currents drifting icebergs from the north. The same result has been worked out in Scotland by Mr. Jamieson, and in North Wales by Prof. Ramsay, and now geologists are agreed that at the time of the greatest developement of the ice in Europe, the land was elevated above its present level and covered with ice, which descending from the higher ranges, deepened and widened the valleys down which it flowed.

The continent of North America is more glaciated than that of