

ART. II. ON THE FOOD FISHES OF NOVA SCOTIA. No. VI.
 BY J. BERNARD GILPIN, A. B., M. D., M. R. C. S.

(Read December, 1867.)

THE SHAD.

Alosa Prestabilis, (DeKay.)
Alosa Tyrannus, (Gill from Latrobe.)
Alosa Vulgaris, (Storer.)

Description of a shad from the Shubenacadie river. One of four procured for the Paris Exposition, 1867, July 17, 1866:—

Length of head, 3 6-10 inch.
 Length to base of tail, 16 inches.
 Breadth at deepest part, 5 inches.
 From tip of nose to orbit, 9-10 inch.

The general outline. Head very small. The back rounding up suddenly from the opercles and making a bold convexity to dorsal fin, from thence descending to tail. The outline of belly very convex. A short thick fish. The upper jaw notched, the lower when open seemingly longer than upper, when closed of the same length. Colour, silvery from below to ridge of back, with a fine light reddish bronze catching about the sides. Top of back bluish ash, top of head greenish horn, sides of head and opercles yellowish and bronze with a few radiating striæ; a row of spots of dark blue, commencing with one large one behind upper angle of opercle and extending along the sides to opposite posterior edge of dorsal fin—(when covered by scales these spots are not so distinct.) Dorsal and caudal fins bluish ash with dark extremities, ventral and anal light yellow. Pectoral light yellow, with dark upper edge. Rim of belly strongly serrated. Thirty-seven or eight points on edge of belly from gills to anus, some sharp, others worn down. No raised line of scales. Scales very large and irregularly circular. A large caudal pouch or scale, irides silvery, eye not filling up the orbit, nostril one-third nearer tip of nose than orbit. Toothless. Branchiostegal rays square pointed 7 of aside. D. 17, (counting the two first very short ones as rays), P. 17, V. 8, A. 17. Dorsal irregularly rhomboidal, caudal deeply cleft and much frayed and worn.

Weight above four pounds.

Nov. 14, 1868. Two shad were brought to Halifax fish market of this date. They were taken amongst some mackerel. In colour they were dark blue on the back, silvery on the sides, with none of that cupreous reflection in the summer specimens. The large humeral spot was scarcely to be distinguished, and instead of one line of small spots reaching only to posterior edge of dorsal, two lines of spots, each reaching nearly to tail, were present. The opercles and head were cupreous or bronzed and pointed with small black dots. The striæ on the opercle were much defined and in parallel and slanting lines. They were lean and out of condition. The double row of spots is the more remarkable as they seem to be the typical mark of DeKay's species,—“Matawoaca.” Being found so late in the season on our coast is a proof of their not migrating southward during winter, and I fancy of very rare occurrence.

Such is the description of this excellent fish as it appears in our waters about the middle of June, remaining about a month. They are seldom taken on the Atlantic coast, and never in quantities, but are brought to our market from the Avon and Shubenacadie. They are also taken in St. Mary's Bay, and in fact in all the bays terminating at ebb in muddy flats that flow into the Bay of Fundy. The Annapolis basin is seemingly too sandy for them, as they resort in much less numbers to it. According to DeKay, they appear at Charleston, S. C., in January, at Norfolk, Va., in February, New York, March or beginning of April, and Boston end of April. Perley says they appear in the Bay of Fundy middle of May and ascend the St. John river to spawn, and ascend the Miramichi river end of May,—their most northern limit. From this data he infers that the great body of fish perform an annual migration from the south to the north, returning in the fall. It is much more probable that the whole body winter in deep soundings parallel with the entire American coast, and as the waters of the Potomac, the Chesapeake, the Delaware, the Hudson, and the Connecticut, the St. John and the Miramichi are successively warmed by the returning spring, that portion opposite to each enter for the purpose of spawning, and return again to deep soundings. Otherwise one would have to suppose that of a body of shad near Charleston, all seized in January with the resistless instinct of reproduction, one part sought immediate and direct relief in the nearest rivers, the others made a long and laborious journey to waters then frozen stiff in ice—the rivers of New Brunswick and Nova Scotia. Such a supposition is untenable. From Perley we learn that they spawn in the lakes communicating with the St. John river in May, return immediately and resort to the mud flats at the head of the Bay of Fundy, to feed upon shrimps and a large worm called shad worm, found burrowing in the mud flats at the ebb-tide, and that this food gives them that exquisite flavour for which the Bay of Fundy shad are justly celebrated. No spawn is found in them at this season. From Messrs. Treat & Son, we find that their eggs spawned in June were hatched in three weeks, and in three months were able to seek the ocean. Frank Forrester affirms that their flesh is

much preferred to turbot by fastidious epicures. It has the quality of softness and melting in the mouth, different from the firm flakiness of the salmon or haddock. Coming to us by land, and during the salmon season, perhaps it has not that attention given it that its savouriness deserves. When salted it affords a good item of export. In 1860, eight thousand barrels were exported. The exports of later years have not been returned separately from salmon in the blue book of Nova Scotia. As there are few or none on the Atlantic coast of the Province, I have not personally studied their habits, having only seen the drift fishing of the Avon. Here the boat, with one hundred or one hundred and fifty fathoms of seine payed out from its stern, drifts on the ebb and returns upon the flood, the seine held upon the surface by its head line of floats, being about three fathoms deep. The shad are picked out, meshed at intervals along the seine, which is twisted and knotted into a mass of apparently hopeless and impossible confusion. Father Gavreaux, priest missionary as he records himself, in a capital letter to Mr. Perley, 1850, gives a pleasant account of the shad fisheries among his French people, on the New Brunswick side of the bay of Fundy. He also states that the finest fish are taken at the end of the season, about the middle of September, and that in them, a blue band along the back represents the ordinary green or bluish green color. This is worthy of note as analogous with the same change in the gaspereaux, a smaller congener of the same family, upon which some naturalists have founded a new species. This letter is filled with numerous facts and remarks upon their food and habits, valuable as coming from an intelligent, educated and zealous man, and to quote his own words, "seen with mine own eyes, in my own boat, my St. Peter, when attending weir fishing for dog fish on the flood tide, and particularly enjoying myself at low water in catching the flirting shad inside the weir." This is language of an educated observer of nature, and is well understood by all who have had the privilege of loitering about and covering themselves with the mud and slime of a teeming stake net or weir. Convinced that fishing by weirs was destructive to the fish, and that drift fishing was more productive, this gentleman purchased

a boat of his own, with nets, worked her himself one season, and caught two barrels. To use his own language, "the experiment spoke well by my example and exertions; in three years twenty French boats followed me. In 1850, one hundred fishing boats were counted drifting down the Bay, all fine fast weatherly boats prepared for any storm." The usual amount of the catch of these French Acadians was 1500 bbls. Let us be thankful that there is an Acadie still left, where an educated gentlemen and a pious priest can take the oar and hook in his hand as well as the chalice and the cross, and doing both in the sole desire of his people's welfare, be thus followed and appreciated by them.

This fish was for a long time confounded with the English or Alice shad, *Harenga alosa* (Linn., Gunther), and is so given by Storer. DeKay gives to it the name, *Alosa Prestabilis*, taking Cuvier's new genus *Alosa*, and gives the distinctive marks from the Alice shad. Dr. Gill (Synopsis Fishes Bay of Fundy,) restores to it the name *alosa tyrannus*, from Latrobe, and in a note to me states his reasons for supposing Latrobe referred to shad by this specific. Dr. Gill's authority on American fishes will always command attention. In Gunther's catalogue (British Museum) there are no Atlantic specimens of shad, 1867. It only remains for me to mention these various opinions, and to lament the want of a good text book on the Atlantic fish brought down to the present day with all modern additions.

THE HALIBUT.

Pleuronictes Hypoglossus, (Linn., Gunther.)

Hypoglossus Vulgaris, (Cuvier and Valenciennes, DeKay, Storer).

Hypoglossus Americanus (Gill.)

In describing this large flat fish it is usual to consider it placed upon its lower edge with the tail towards the observer, and to call its sides right or left as they present. In this species the eyes are always on the right side, which is always dark brownish ash, and the left always white. Individuals rarely have been seen the reverse and with both sides dark. This description was taken from a specimen at the Halifax fish market, about two feet and a half long, weighing about twenty pounds.

The eyes both on the right side, irides silvery with bronze streaks, the right orbit smaller than the left, the eye itself apparently smaller, and raised above the orbit, being guarded by a skin on the upper edge like those in the frog, and nearly touching the intermaxillar bones forming the lips. The left orbit larger. The left eye larger, and at least one diameter of orbit from the nose, and sunk deeper in the orbit. The nostrils double the second tubular, the right nearly midway between the orbit, the left in a line of posterior edge of left eye. The upper lip is divided by a deep sulcus from the nose, and is formed by the intermaxillar and maxillar bones, the maxillar fitting as in the cod into a groove. The lower lips are longer than the upper, with also a deep line passing around them; both the upper and lower are fleshy. The line of pre-opercle is roundish, posterior edge of opercle commencing with a round turn, ends in a sharp point, the apex of which is opposite insertion of pectoral. The upper and lower jaws and opercles though differing in colour will be found on careful inspection symmetrical. The ventral fins inserted about their length from gills very small, six rayed. The left a little smaller than right. The pectoral fins small ovate, fifteen rays, counting the first short one, the third the longest, the right pectoral about one-fourth larger than the left. The dorsal fin commences in line with the left eye. The first twenty-four rays when closed fitting in a sulcus along the back. The rays each tipped with a soft point, commence small and gradually increase to a little beyond the half of the length of the fish, then diminish gradually, and end nearly at insertion of caudal. It contains about one hundred rays. The anal fin commences about double the length of the ventral fins from gills, and has the same general arrangement of rays as the dorsal, and ends opposite to it, having the same soft tips to each ray, which are about seventy-four in number. The caudal has seventeen and four short ones, and is crescent shaped. The general shape of the fish is a long round angled rhomboid. The vent being in front of the insertion of anal, which is only double the length of the very small ventral from the gills; it necessarily follows that the whole capacity for stomach and intestines, is scarcely a fifth of the whole fish. The upper or right side and part of the head and opercles are covered by scales so minute that they appear more like marks in the mucus thickly covering the skin; a raised line of scales on the right side commences immediately behind the opercle, arches rapidly on the pectoral and runs straight to tail in a line with the vertebra, and on the left side there is a faint white line corresponding to it. In the upper jaw there is a double irregular row of large and small sharp pointed teeth, pointing downwards; in the lower jaw a single row, in this and many other specimens, but from its irregularity I have no doubt that DeKay is right in giving a double row in the description of his. The colour of the right or upper side is dark brownish ash, of the lower pure white. That of the dorsal, anal caudal, right ventral and right pectoral is the same, but the left ventral and pectoral have both sides pure white. The lower or under edge of the jaw is covered with minute black dots. In saying the right eye protruded beyond the orbit more than the left, I meant it as studying the dead fish only; but having noticed it so often I cannot forbear mentioning it. In the living fish I have no doubt both eyes protrude like those of the frog, and are protected by a thickened coat of the sclerotic membrane.

Branch rays 6-7, D. 100, P. 15, V. 6, A. 75, C. 17½

In studying this fish we find as it were an ordinary fish,

highly compressed, then thrown upon its left side, and its mouth violently twisted to the right. Thus modified it becomes a bottom feeder, having no air bladder, perhaps never coming voluntarily to the surface. It must be confessed that the almost universal law of dual symmetry, is in part violated; but how little in so strange an alteration is a marvel to the observer. The ramus of either jaw is symmetrical, could we only twist it back again, the opercles are the same, there is even an attempt of a lateral line on the lower side. There is a slight difference in the size of the pectoral and ventral fins, relatively to each pair, the under ones being smaller. The right eye and orbit smaller than the left ones. From the lip thrown back and the twist of the mouth throwing the right eyes from the central spine, it makes the right optic nerve longer than the left. The optic nerves do not decausate, but join each other before entering the brain, which is exceedingly small and resembling a series of lobes. Indeed the spinal cord is smaller than one of the optic nerves. On turning the fish with its lower or white side up, and opening the abdomen, we find all the intestines very small, but holding the same position relatively to it as in other fish. The heart very small and tri-cornered. The liver lying in front of the stomach, light yellow and small, with a gall bladder on its upper edge. The stomach nearly circular, very muscular, and so reflected that with the intestines they resemble a double coil of rope, no air-bladder, one large cœcum, and large venous sinuses along the spine. The ovaries were tri-cornered, with a long oviduct. The spleen was large. In observing the movements of the smaller flat fish, I noticed they were propelled by a series of contractions, commencing at the tail, (the term, fluttering, expresses my idea,) and passing through the body and dorsal and anal fins. Their motions are very quick, and doubtless this huge bottom feeder, attaining, in rare instances, six hundred weight, must thus range along the bottom of the deep soundings where he chiefly loves to dwell, his eyes protruding like a frog from the back, and his right side slightly elevated from the bottom, so as to strike the water obliquely. He must seize his living prey from below. The upward twist of his mouth coincides with this view. He must meet with few antagonists of equal power

amongst the hosts who people these many fathomed depths. Cod, haddock, pollock, hake, cusk or ling, herring, mackerel, cat fish, (*A. Lupus*) sea perch, (*C. Burgal*) and squid are found in his stomach. In fact every species that inhabit our seas. But we are less prepared for the various mollusks that are also found there. My friend Mr. J. R. Willis, so well known as a conchologist, has kindly given me a list of specimens, which he has at various times taken from their stomachs.* Many of these species must be in beds at the bottom of the ocean and must be torn or rooted from their attachments. We can only suppose there must be shelving banks and inequalities of the surface on whose sides the mollusks bed themselves, and that the halibut thus get beneath them in feeding upon them. Like all our fish they approach the land during the summer months and retire to the deep soundings during winter. They spawn in June, at least at that time the ovaries are the largest and the spawn escaping the most readily from the female when caught. Small fish of the size of the spread hand are taken both in our shore weirs and also on the banks, showing they spawn in both places. They are seen every month in our fish markets, but the best fishing season is in early spring, on the banks about ninety miles seaward, with sixty to eighty fathoms. The season commences the last of February or first of March; but the seas are too tempestuous and storms too violent for much to be done at so early a period. The meat when fresh is firm, white, and well flavored, either boiled or fried in cutlets, or spiced and baked. It does not take salt well. This is not much to be regretted on

* NOTE.—The following I have taken from their stomachs frequently uninjured, apparently just swallowed whole, but sometimes affected by the gastric juice, or else in fragments.

Glycimeris, siliqua.
 Astarte, castanea.
 Cyprinus Islandicus.
 Leda sapolita.
 Pecten, Islandicus.
 Natica, triseriata.
 Lunatica, heros.
 Fusus, decemcostatus.
 Fusus Islandicus.
 Fusus pygmaeus.

Occasionally I have found the remains of cephalopods, but too much injured by gastric juice to enable me to identify any of them with certainty.

Yours sincerely,
 J. R. WILLIS.

the Atlantic coast, as it sells readily when fresh, its price often exceeding that of fresh mutton. The easier communication by steam with the neighbouring States has caused a large trade in fresh halibut preserved in iced boxes. At least £2000 worth are sent by steamers to Boston from Halifax during the season. All the American writers, with the exception of Gill, consider this fish identical with the European species. Gill by giving it the specific *Americanus* must consider it different. As its northern range is Greenland, it is most probable that commencing from a northern origin it has spread on both sides of the Atlantic.

With this large and curious member of the family of Planide I finish the Food fishes of Nova Scotia. The turning, so to speak, perpendicular into horizontal motion, the thin upright compressed fish into the broad flat one is effected so easily and so naturally, and with so slight a fracture of dual symmetry, that one wonders it has not attracted more attention, or that it has not been a fruitful theme for Darwinism. In these papers I have endeavoured to give all the facts at my command upon the food, the habits, the spawning time, and upon the minute exterior appearance and typical marks of the five families of Clupidæ, Gadidæ, Salmonidæ, Scomboidæ and Planide, which represent our food fish. I have at least made a beginning, though an imperfect one, being convinced that this is the only and proper way to approach the subject of our fisheries,—to determine whether they have declined or no, and the cause of that declension provided it is proved to exist. The question of food for at least the surface feeders,—how far its supply is modified by the winds and currents setting along the fishing grounds,—how far by the power of man,—must also be thoroughly studied. Many of these influences are doubtless beyond our controul; but the very knowledge of what is beyond our controul adds much to our capacity for holding and using what is within it. Many supposed facts, now reasoned upon as facts, must be entirely dropped, as for instance the Americans feeding the mackerel, and thus drawing them away from our shores. It would take the capacity of the *Great Eastern* and the national purse, to feed for one season the millions that swarm our seas. Another

that the bultow or set lines are destroying the fisheries. Bultow fishing only means that more fish are taken in a given time than by hand fishing. That in the inshore fishing, individuals do less than formerly, and also find more difficulty in obtaining bait, I believe to be true, simply because more men and boats and nets are employed, and thus the fisheries are divided. A narrow coast line becomes overfished, and bait become scarce in a limited range; but this ceases to be true on the limitless range of ocean banks. The returns of imported fish show a steady increase annually. Yet every individual shore fisherman will tell you, and doubtless sincerely, that it is decreasing, thinking only of his own small catch.

That fifty sail of American fishermen are at one time in some of our out-harbours purchasing bait; that many of them carry ice boxes, for preserving bait, to sea with them, are both significant facts of the scarcity of bait, and of what our coast fisheries must soon come to. With the exports of fresh fish, the fresh fish consumed at Halifax and in the Province, and the fish oils, we may put the annual value at about \$4,000,000. This is large for a Province not enumerating 400,000 people. We may also state, that, as regards cod fishing, more than three-fourths of its value arises from coast fishing. That is, each individual hardy yeoman of the sea keeps his own rock hung cot, his boats, his net, and makes his own pile of fish, bringing it himself to market. The produce of this fishing is called shore caught, and commands a higher price than the Labrador catch, on account of the fish being brought to shore and cured immediately. The Labrador catch being pickled on board, and cured on the return of the voyage. It is manifest that it is in the interest of this class of fishermen, that legislation, if at all, should be obtained, that ice houses to preserve bait should be encouraged, perhaps by small grants, and perhaps some prohibitory laws, against exporting fish bait, though it must be confessed that all prohibitory legislation is of doubtful benefit, and when not founded on exact knowledge of facts often acts injuriously. That there is a growing deficiency of bait, and hence of fish following that bait to the shore, I think, must be admitted, though much exaggerated by the fishermen themselves. If this can be

remedied by any means, then the coast fishing will return; if partially remedied then the coast fisheries will only be retarded in their gradual absorption into ocean and bank fishing. The single men, who now each in his own boat takes his own fish, must club into tens, build fishing smacks, and commence ocean fishing. That is to say, capital must come to assist labour. That more fish will be produced, it is probable, but the individual fisherman will suffer. From being a yeoman of the sea, and owning his own boat, he will become the servant of the capitalist—or the man who puts the most value in the joint stock. For one, I would be sorry to see the Nova Scotian fisherman reduced to the Newfoundland fisherman. The presence of capital has the great and good effect of tiding over temporary scarcities. It always has its accumulations. But one who is familiar with the half-dozen fishing villages, hanging up as it were on the rocks of our out-harbors, with their tidy kitchens, and neat bed rooms, their well fed children, and well clothed men, their neat boats and nets, and compares it with the state of the oppidan laborer, mechanic or truckman, living usually in one or two rooms of an evil smelling house in a dingy street, must look with concern at any causes that are slowly causing them to pass away.

ART. III. NOTES ON THE ECONOMIC MINERALOGY OF NOVA SCOTIA. BY PROF. HOW, D. C. L., *University of King's College, Windsor, N. S.* PART IV. GYPSUM AND ANHYDRITE AND THE BORATES AND OTHER MINERALS THEY CONTAIN.

(Read November 4th, 1867.)

In the present paper I propose to consider the immense deposits of gypsum and anhydrite which have long been of great economic importance to the Province, and the minerals found in them, some of which, being useful, will add much to the value of the plaster quarries, if abundant. The term plaster, just used, being employed locally as the name both of gypsum and anhydrite, I shall avail myself of it occasionally as convenient, and may mention that gypsum is sulphate of lime with