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ON THE FAUNA OF THE ATLANTIC COAST OF CANADA.

AN INTRODUCTORY REPORT

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The establishment of a marine biological station for Canada offered an opportunity for a zoological survey of our eastern coast waters. Although the task must be a long and arduous one, yet enough has already been done to indicate some interesting features in the Atlantic marine fauna and to show the advisability of continuing its investigation. Before the establishment of the station, thanks to the enthusiasm of certain zoologists of Canada and of the United States, there had already been published a number of valuable lists of many classes of animals. But with the advantages of a portable laboratory, moving periodically and by successive stages along our coast, and equipped with the more necessary appliances, facilities have been furnished for a fuller systematic survey than was otherwise possible. The development of a marine laboratory must itself be gradual, and in the initial stages of its growth we can not look for the same thoroughness or comprehensiveness of results as in the later stages to which fall the legacies of a more complete outfit for collecting, and improved apparatus for experimenting, together with a more inclusive library and an experienced staff.

The biological station has been in existence since 1899; the first two seasons were spent at St. Andrews, New Brunswick, and the succeeding two at Canso, Nova Scotia.

In the summer of 1899, several weeks before the carpenters had completed the building at St. Andrews, a small but enthusiastic staff of workers commenced researches there. A row-boat or a hired sail-boat was alone available, and much time was lost in reaching the best grounds, indeed it was often out of all proportion to the real time of collecting; but there was the advantage of a rich faunistic district, offering many facilities for collecting from shore.

In 1900 there was built a 22-foot gasoline launch which gave only a few weeks' service and then had to undergo some change of fittings. A small steamer, the *Annie*, of St. Stephen, was hired for about the same length of time, in which longer trips were made. Altogether the work of the staff at St. Andrews occupied seven weeks of the first year, and fourteen weeks of the second.

In the spring of 1901 the laboratory was mounted on a scow, built at St. John, and was towed around the coast by the Dominion fishery cruiser *Curlew* to Canso N.S.. Here, through the liberality of the Messrs. Whitman, one or more of the staff had the advantage of being frequently taken to the local fishing banks on their steamer *Active*, whose crew also often brought back 'curios' captured by their trawl-hooks. On a few occasions also the same firm kindly gave the use of their tugboat *Vulcan*, and several men, with which to test the 12-foot beam trawl used for experiments.

Upon resuming work at Canso in 1902 the launch was put in order, and, while very useful for short distances, she proved not sufficiently speedy or even safe to venture out to deep water. As the station could not derive much benefit from the *Active*, herself and crew being employed for the greater part of our period of work by the wrecked *Blaamanden*, the staff was so far at a disadvantage. From a consideration of our means of locomotion up to the present, it seems worth while to mention that the first requirement of the station is a vessel large enough and sufficiently seaworthy to carry on work in deeper waters. This has been continually apparent at

Canso, where we could scarcely go any distance from home without being exposed to some danger in the open sea. The coast being bold and rocky yields little to the shore collector and, as a consequence, reliance had to be placed on netting and dredging. But these again we could only perform near shore and for the latter a rocky bottom is unproductive. Rarely has the dredge been used beyond fifty fathoms, and this for two reasons: first, because of our inability to go far out from shore, and second, because of the impossibility of hauling up the dredge by hand from a much greater depth.

Work was conducted at Canso 17 weeks in 1901 and 19 weeks in 1902—in the first of these years for a month before the arrival of the station, in the second, which was the longest term yet spent at the station, from May 1 to September 20. May and part of June were so cold and windy that it was unsafe to venture against the unmanageably rough seas. Hence time was profitably spent in collecting from shore, examining fish brought to the wharfs by steamers and schooners, or working over former collections made at the station.

With these brief references to the areas examined, the time spent in work each season and the means of visiting various localities it is appropriate to mention the methods of collecting. These of course differ according to the nature of the collecting ground and the kinds of animals sought. An excursion along the shore, especially after a storm, yields animals washed up on the beach, some of which, like sponges and jelly-fish, may have been brought long distances. An examination of the sea-weed may prove fruitful in crustacea, snails, worms and the like. With long rubber boots, a pail and a dip-net, one can wade in the water and look for ctenophores, shoals of shrimps and small fish. The turning over of stones between tide marks is most fruitful and reveals numerous species of worms, clams, &c., which may also be procured by digging with a spade into gravelly, sandy, or muddy ground in similar localities. About low-water mark is often to be found a different assemblage of animals, consisting of star-fish, brittle-stars, sea-urchins, sea-cucumbers, &c., and flat stones below the lowest tide-marks may shelter under them sponges, worms, molluscs, echinoderms, tunicates, &c., as well as the eggs and larvæ of many different species. Much can be learned by such procedure, and sometimes one may come upon rare specimens in the most unexpected positions.

With a boat the piles of wharfs, the timbers of piers, the stakes of brush-weirs, the sides of ships below the water-line, may be examined; old lobster pots and such objects, that may have lain for some time in the sea-water, may be hauled up and searched; and the shores of islands reached and investigated. On the way the water is scanned and the dip-net is kept to hand, a large net may be towed behind the boat, or small close-meshed nets may be towed along the surface or weighted to sink to different levels. These catch the small adult forms and larvæ that constitute the food of many fish, and some of the latter may be obtained by hook and line, while others may be secured in shallower water. To procure animals that live on the bottom a dredge, consisting of a quadrangular iron frame with a net attached at one side and a bale at the other, is dragged by a long rope let out behind the boat. The flat jaws of iron scrape off sponges, mollusca, echinoderms, &c., from the rocks which fall into the net behind, or collect shells and stones with hydroids, bryozoa and tunicates attached or mud containing worms and shells. Both the propulsion of the boat and the hauling of the dredge are best performed by machinery, but the smallness of the station's boats prohibits the use of a winch. Generally it has been found more productive to row the boat. Propelled by sail or by the engine the speed is usually sufficient to raise the small dredges off the bottom, but often good catches have been made by simply allowing the boat to drift with the wind or in a surface current. The beam-trawl, already mentioned, consists of a strong beam 12 feet long supported on runners a couple of feet from the ground. Behind is attached a large long-pointed, coarse-meshed net of strong cord. The lower lip of this is strengthened by a rope weighted by small rods of lead, and hangs loosely on the ground into the depressions of which it falls. A rope bale is attached in front, and the whole is dragged by a long rope

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after a vessel under considerable headway. This covers a greater area than a dredge, and besides collecting many of the same kinds of animals it also picks up larger objects and captures fish—particularly flat fish.

We have hitherto considered only those animals that are to be found on the surface, or that live deeper in the sea, those that feed on the bottom, that burrow in the ocean-bed, or that creep over rocks or seaweeds. There are others that gnaw their way through and destroy the timbers of wharfs and ships, as well as those that creep over the surfaces of larger animals or fix themselves to definite parts of the skin or gills. One step further, and the collector may find animals that have penetrated into the bodies of others and have even become so completely reconciled to their new homes that they could not possibly continue to live if they were set free.

Live animals taken to the laboratory can usually be kept some time by occasionally changing the sea-water. Better results are reached by supplying the small glass aquaria with sea-weeds, gravel, &c. At Canso two coal-oil pumps were worked at the station so that both salt and fresh water were supplied to the laboratory tanks, and when necessary the aquaria could be thus continually replenished with fresh sea-water. In this way many animals, like sea-anemones, could be induced to expand their tentacles and give an opportunity for their study more conveniently than in their natural habitat.

The first location of the station at St. Andrews presented many special advantages. Its southerly sheltered situation implied, close at hand, a rich and varied fauna, while further out deep-water forms were also obtained, in Passamaquoddy bay and the entrance to the Bay of Fundy. Passamaquoddy bay, screened from the great Bay of Fundy by a chain of islands, is a body of water some 15 miles long by 7 broad. The tide rises and falls about 28 feet, making an enormous difference in the appearance of the shore and exerting a vast influence not only upon the habits of many marine animals, but even extending to the inhabitants of the coast. At many places the falling tide exposes this depth of nearly perpendicular rocks, in the crevices and fissures of which may be found numerous species of invertebrate animals. At other places the shore slants more or less gradually, leaving broad areas of rock, gravel, sand or mud, with animals adapted to every condition. Where the laboratory stood, on the east side of 'the point,' facing Malloch's weir, the lowest tides receded nearly 400 yards. With the rising tide strong currents are swept inwards, between the islands, carrying hosts of marine animals. When the tide falls again numbers of these are left stranded on the beach, or confined in small pools easily accessible to the collector. Approaching the large rivers that empty into the bay one finds other conditions, varying from saline through brackish to fresh water. Turn what way he will, an observer is likely to come upon the common star-fish in many colour-varieties, the sea-urchin and the sea-cucumber, among echinoderms. The mollusca are abundantly represented by the edible mussel, the horse-mussel and the clam, long and round whelks, the purple shell, the periwinkle, and the limpet. Nereis, Arenicola, Nephthys, Rhynchobolus, Lepidonotus, Amphitrite, and Lineus are common representative of the worms; while crabs, hermit crabs, barnacles and sand-hoppers are the commonest types of crustacea. A good many hydroids, polyzoa, and sponges may also be easily procured along shore.

The best collecting places are reached at the period of lowest tides that occur only at the beginning and in the middle of each month. At such times one can wade into the water on the southwest side of the outermost limits of 'the point,' near St. Andrew's, and at arm's depth feel under the projecting ledges or turn over flat stones that are never left uncovered and are not accessible at other periods. This is probably the best place on the coast for sea-peaches (*Cynthia pyri formis*), but many other animals such as Nudibranchs and Sunstars (*Solaster*) occur. In fine sand at about half-tide mark just south of 'the bar' by Malloch's weir, I dug up the only specimens of *Balanoglossus* and of *Edwardsia* yet procured at the station. The north side and outer end of this bar are also good collecting places, where the sea-orange (*Psolus Fabricii*) may be picked by hand. The entrance to Katy's Cove

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furnishes numerous forms, among which may be mentioned Chirodota, under the mussel beds to the left of the railway bridge; and farther inwards, around the remains of a former dam, are large-sized limpets and tube-worms. Craig's Ledges, on the upper side of the entrance to Chamcook harbour, are resorts rich in sea-anemones, brittle-stars, &c., as are also tide-pools near the outer, rocky end of Pendleton's island. In one of these, small enough to be jumped over and deep as one's waist, supported by a big rock on the side towards the water, and situated at about half-tide mark, during two successive summers, a great collection of animals appeared, comprising many species, among which may be mentioned a brachiopod (*Terebratulina*) which is usually procured only by dredging, and a tube-worm (*Amphitrite*). Nearby in fine sand occurs a species of *Enchytraeus*. The 'western block' on the bar between St. Andrew's and the island, and other places, were frequently visited and might be mentioned, but this must suffice.

The dredge was used in the St. Croix river above Docket Island, between Joe's point and Robbin's Town, off all sides of St. Andrew's Island, up the bay towards the mouths of the Bocabec, Digdequash and Magaguadavic rivers, and once we went as far east as L'Etang and dredged scallops, landing on Frye's island at low water when returning. Opposite where the station stood we dredged at many places round the light-house (Sand Reef Light) and off McMaster's, Pendleton's and Deer islands. We also dredged off Pleasant point, and once went as far south as Eastport, Campobello island, and Lubec Narrows. This last is a rich and interesting region, and it is to be regretted that the staff were unable to examine it thoroughly as well as to visit Grand Manan.

The fisheries of economic importance at St. Andrew's are chiefly cod, haddock, pollock, herring, mackerel, and clams and lobsters.

At Canso the tidal water rises and falls only about 4 feet, affecting but a narrow belt of the shore. There are few accessible rich collecting spots, the coast being generally rocky with here and there small beaches of rounded stones, but seldom gravel, sand or mud. Wherever stones large enough for protection to animals and small enough to be moved by the collector do occur there is intolerably rough water producing friction fatal to delicate animal forms. At such places the stones, worn round and smooth by constant rolling and grinding, are heaped in enormous masses, while at other places they are laid out like pavement stones and solidly cemented into the beach.

At low water mark the star fishes and sea-urchins, which are a feature of the St. Andrew's region do not appear; these, however, may be found in limited numbers under wharfs or at places up the centre of Tickle channel; but sea-cucumbers, that at St. Andrew's may be found clinging to the ledges or arranged by the score in beds below the lowest tide limits, are scarcely ever seen at Canso; only two or three that were brought from deep water were secured. Sea anemones flourish under the wharfs and especially at French Point, where large brown, gray, yellow and orange Metridia occur side by side in the fissures of rocks. At this point too the horse-mussel and the edible mussel occur, but the latter may be obtained abundantly at the 'breakwater' (Grave Island). Clams are scarce, but may be found, together with a few razor shells (*Solen*), at Grassy Island and Publicover Beach. The large round whelk may be procured at Indian Cove, and the long whelk, together with the purple shell, the periwinkle, and little limpets, in small numbers at Glasgow Head. Various Nudibranchs live on the sea-weeds under certain wharfs, and fine specimens of *Æolis papillosa* under stones in the narrow channel between Piscatiqui and George Islands. Calcareous sponges, hydroids, and bryozoa occur on the submerged timbers of wharfs or on the sea-weeds to be found there or especially at Cranberry Islands. Arenicola, Nereis, Nephtys and other worms may be dug up from Llanigan Beach, where the laboratory stood, and in Grassy Island Cove and Publicover Beach. The sessile barnacle, the sand shrimp and the crab are the chief crustaceans, but lobsters, so plentiful in deep water among the islands, may be occasionally seen lurking under the edges of rocks along shore.

Dredgings were made at various places in Chedabucto Bay, e.g., at Crow Harbour, on Hydra Shoal, across the entrance to the Gut of Canso, and from that eastward be-

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tween Canso and Isle Madame as far as to Green Island. Near Canso, areas were dredged from Tickle Island to the eastward, encircling Derabie Islands and Cranberry Islands, to Cape Canso, and at many places in the harbours and between the islands.

Professor Prince, Professor Ramsay Wright, and others had the opportunity of being on the Mackay-Bennett cable-repairing steamer, and I had the advantage of remaining on board for a couple of days in Dover Bay and saw what animals were brought up on the cables as they were raised.

The most successful places dredged during the two seasons were to the north-east of Tickle Island and Durell Island, and outward from the bell-buoy in a line with the channel entering Canso Harbour from the west. Here occur calcareous and other sponges, a couple of species of sea-orange (*Psolus*), *Myriotrochus*, *Eupyrgus*, and one or two commoner Holothurians. Mussel shells dredged at the entrance to Grassy Island Cove have *Crepidulas* attached.

Although Canso is not a point exceptionally favourable from which to collect invertebrates in numbers, yet, in one way or another, specimens were procured of most of the species obtained at St. Andrew's, besides a few others. Its proximity to some of the best fishing banks in the world is sufficient proof that there exist somewhere in the adjacent waters vast quantities of smaller animals upon which the fishes feed. The most valuable of these fisheries, as is well known, are the cod, haddock, pollock, mackerel, salmon, halibut, the lobster, and the squid.

As the member of the staff charged largely with the collection of specimens and their storage for purposes of study, &c., a vast amount of the material obtained since the station was founded has passed through my hands. In spite of an inadequate supply of literature necessary for accurate determination of species, I have been able to prepare a list, which when finally revised will be a basis for future work. I shall give here a list of the Porifera, the Cœlenterata with the exception of the smaller hydroids, and the Echinodermata, and propose in further papers to add to the present contribution, after the specimens have been more completely worked over, and others collected from more northerly areas.

PORIFERA.

Ascoris fragilis, Haeckel—St. Andrew's, Canso.

Leucosolenia cancellata, Verrill—St. Andrew's Canso.

Sycon protectum, Lambe—Canso.

Leucandra cyathus, Verrill—Canso.

Amphoriscus Thompsoni, Lambe—Canso.

Polymastia robusta, Bowerbank—St. Andrew's.

Suberites suberea, Johnston—Canso.

Halichondria panicea Johnston—St. Andrew's, Canso.

Reniera aqueductus, O. Schmidt—Canso.

Eumastia sitiens, O. Schmidt—St. Andrew's.

Chalina oculata (Pallas), Bowerbank—St. Andrew's, Canso.

Chalina Sp.—Canso.

Pachychalina, Sp.—St. Andrew's.

Myxilla Behringensis, Lambe—St. Andrew's, Canso.

Desmacidon palmata, Johnston—Canso.

Esperella lingua, Bowerbank—St. Andrew's, Canso.

Esperella modesta, Lambe—Canso.

Plakellia ventilabrum, Johnston—Canso.

————— (on brachiopods)---St. Andrew's, Canso---Sponge, genus and species undetermined.

————— (Tall, rough cylinders, on rocks)---Canso---Sponge, genus and species undetermined.

Halisarca Dujardinii, Johnston—Canso.

COELENTERATA.

- Ptychogena lactea*, A. Agassiz (medusa)—St. Andrew's.
Tiaropsis diademata, A. Agassiz (medusa)—St. Andrew's.
Tima formosa, L. Agassiz (medusa)—Canso.
Polycanna Grænlandica, Peron et Lesueur (medusa)—Canso.
Physalia pelagica, Lamarck—Canso.
Cyanea arctica, Peron et Lesueur—St. Andrew's, Canso.
Aurelia flavidula, Peron et Lesueur—St. Andrew's, Canso.
Alcyonium rubiforme, Ehrenberg—Canso.
Alcyonium carneum, L. Agassiz—Canso.
Alcyonium Sp. (big, lilac-like)—Canso.
Epizoanthus incrustatus, Duben and Koren—Canso.
Edwardsia sipunculoides, Stimpson—St. Andrew's.
Metridium dianthus, Ellis—St. Andrew's, Canso.
Chondractinia nodosa, Fabricius—Canso.
Actinauge Verillii, McMurrich—Canso.
Stomphia carneola, Stimpson—St. Andrew's, Canso.
Actinostola callosa, Verrill—Canso.
Bolocera Tuedia, Johnston—Canso.
Pleurobrachia rhododactyla, L. Agassiz—St. Andrew's, Canso.
Bolina alata L. Agassiz—St. Andrew's, Canso.
Idyia roseola, L. Agassiz—St. Andrew's, Canso.

ECHINODERMATA.

- Cucumaria frondosa*, Gunnerus—St. Andrew's, Canso.
Cucumaria calcigera, Stimpson—Canso.
Cucumaria minuta, Fabricius—St. Andrew's, Canso.
Psolus Fabricii, Duben and Koren—St. Andrew's, Canso.
Psolus phantapus, Linnæus—Canso.
Thyonidium productum, Ayers—Canso.
Chirodota ferruginea, Verrill—St. Andrew's.
Myriotrochus Rinkii, Steenstrup—Canso.
Eupyrgus scaber, Lutken—Canso.
Trochostoma ooliticum, Pourtales—Canso.
Asterias vulgaris, Stimpson—St. Andrew's, Canso.
Asterias polaris, Muller & Troschel—Canso.
Solaster endeca, Retzius—St. Andrew's, Canso.
Solaster Syrtensis, Verrill—Canso.
Crossaster papposus, Fabricius—St. Andrew's, Canso.
Ctenodiscus crispatus, Retzius—St. Andrew's, Canso.
Pteraster militaris, Müller—St. Andrew's, Canso.
Cribrella sanguinolenta, Müller—St. Andrew's, Canso.
Ophioglypha Sarsii, Lütken—St. Andrew's, Canso.
Ophioglypha robusta, Ayres—St. Andrew's, Canso.
Ophioglypha nodosa, Lütken—Canso.
Amphipholis elegans, Leach—St. Andrew's, Canso.
Ophiopholis aculeata, Linnæus—St. Andrew's, Canso.
Ophiacantha bidentata, Retzius—St. Andrew's, Canso.
Gorgonocephalus Agassizii, Stimpson—St. Andrew's, Canso.
Strongylocentrotus Drobachiensis, Müller—St. Andrew's, Canso.
Echinarachnius parma, Lamarck—St. Andrew's, Canso.