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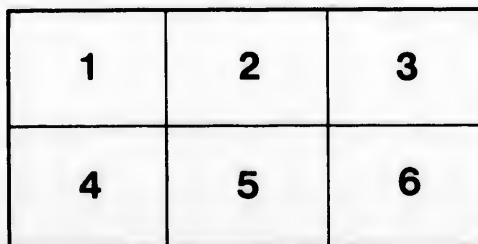
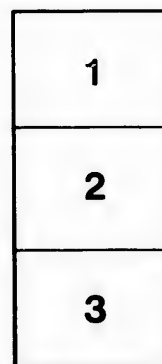
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# BRITISH ASSOCIATION

FOR THE

ADVANCEMENT OF SCIENCE.

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*MONTREAL MEETING, 1884.*

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## The Lighthouse System of Canada,

—BY—

*MR. WILLIAM SMITH, Deputy Minister of Marine of Canada.*

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A Paper prepared at the request of the Executive Committee of the British Association for the Advancement of Science, and read on the 1st September, 1884, before Section G., Mechanical Science.

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SIR F. J. BRAMWELL, F. R. S., V. P. Inst., C. E.,

*President of the Section.*

This paper was prepared for Section F., Economic Science and Statistics, and was intended to show the working and management of the Lighthouse System in Canada, but as Sir James Douglas, the Chief Engineer of the Trinity House, London, had arranged to read a paper on Coast Lighting, and Lighthouse Construction, in Section G., it was deemed advisable that this paper should be transferred from the former to the latter mentioned Section, in order that both papers, relating to the same subject, although treated in a different manner, might be read before the same Section, and appear in the proceedings of the Association together.

# THE LIGHTHOUSE SYSTEM OF CANADA,

BY

MR. WILLIAM SMITH,

*Deputy Minister of Marine of Canada.*

Under the system at present in operation in Canada, no light dues are exacted from any vessels, British or foreign, visiting Canadian ports; and the cost of maintaining our lighthouses, instead of being a tax on the shipping, which derive advantage from the lights, as is the case in the United Kingdom and some other countries, is a direct charge on the general revenue of the country, and is required to be provided for annually by a vote of Parliament. During last fiscal year ending 30th June, 1884, the total cost of maintaining our lighthouses, lightships, steam fog-signals, automatic buoys, bell buoys, ordinary buoys and beacons, including salaries, lighting apparatus, repairs, petroleum oil and all other materials necessary to keep them in an efficient state, was \$456,120, and the cost of the four steamers attending on the lighthouses was \$85,177, making altogether \$541,297. The cost of construction of new lights is not included in the figures above mentioned. It might naturally be asked, why is this system of free lights, which exempts the ships trading to our ports, many of them owned by English shipowners and foreigners, who have no interest in Canada beyond the legitimate one of seeking employment for their vessels in our carrying trade, preferred to the English system, which requires all vessels—British as well as foreign—to contribute their fair share of the cost of maintaining those lights on the coast, which are so essentially necessary to warn them of danger, and to guide them safely to their ports of destination? The answer is easily furnished, and it is this: Canada is deeply interested in securing as large a share as possible of the carrying trade of grain and other products of the west, from this continent to Europe; and in competing with the port of New York and other ports in the United States, for that trade, it is of the utmost importance that all dues and charges on shipping coming to the St. Lawrence, should be reduced to the lowest possible limit, as the freight to be transported naturally finds its way by the cheapest route. If the taxpayer of Canada, therefore, defrays the cost of maintaining the lights on our coasts, instead of requiring the shipowners to maintain them, it is with the view of reducing charges on shipping to a minimum rate, and thereby cheapen the cost of transportation by the St. Lawrence route, and thus secure a fair share of the carrying trade of the west. The competition for this trade is so keen that a difference



of a quarter of a cent per bushel in favor of New York, on the freight of grain from Chicago to Liverpool, will sometimes divert a large portion of it from the St. Lawrence to the New York route. By securing a share of this important trade, we obtain employment for large numbers of our working population, in handling these products; for our railways and inland shipping, in moving them; and the merchant who is engaged in shipping them, also receives his share of the profit. From this explanation it will not be very difficult to understand why the public men of Canada, many years ago, adopted the system of free lights on their coasts; but it was not adopted previous to Confederation in any of the Provinces of New Brunswick, Nova Scotia or Prince Edward Island, and it has not yet been adopted in Newfoundland, the lights in that colony being maintained by the shipping in the same way as they were formerly maintained in the Maritime Provinces referred to, none of them being competitors for any particular carrying trade; and there was no special reason for their adopting the free light system.

In the United States, immediately adjoining us, no light dues have been collected for many years, but during the war between the North and the South, about twenty years ago, it became apparent that a large portion of their carrying trade was being carried on by foreign shipping, and a tax or tonnage duty of thirty cents per ton, payable once a year, was imposed on all shipping entering their ports. This tax was not imposed as light dues, but was generally known as the "war tax" on shipping, and has continued to be collected on all United States and foreign vessels up to this year, when a Bill passed both Houses of their Legislature at Washington, abolishing all tonnage dues on shipping, trading between their own ports or coming from any foreign country which charges no tonnage dues on shipping entering such country from the United States. Unless the light dues in the United Kingdom are abolished, all vessels arriving in the United States from that country will still continue to pay tonnage dues, but instead of paying thirty cents per ton on their first arrival in the United States during the year, as formerly, they will pay six cents per ton each time they arrive till they have paid five times in the year, equal to the old rate of thirty cents per ton, if they make five voyages during the year. The tonnage dues on vessels entering United States ports from Canada and countries adjoining the United States have been reduced to three cents per ton, not exceeding five payments in the year, or fifteen cents per ton per annum. If Canada abolishes all tonnage dues on vessels arriving in ports in the Dominion from the United States, such as sick mariners' dues and river police dues (there being no light dues) then vessels entering United States ports from Canada will be exempted from all tonnage dues.

The amount collected by the United States Government on account of the war tax has been large and assisted very materially in maintaining their very efficient system of lighting their coasts and inland waters. During the year ended 30th June, 1883, the amount collected on account of this tax was \$1,320,590.

Many years ago it was found necessary, in the interests of shipping trading between this continent and Europe, to establish a light at Cape Race, a dangerous point on the southern shores of Newfoundland, but as this light was required principally for shipping which did not enter any of the ports of Newfoundland, the British Government did not consider it advisable to ask the Government of that colony to erect and maintain such an expensive light, as Newfoundland had not the means of collecting the necessary dues from passing vessels using the light, which would be required for its construction and maintenance. The British Government therefore established a light, and subsequently, at the request of Canada, it also placed a powerful steam fog-whistle in connection with the light, both of which have proved exceedingly useful to shipping passing in that neighborhood. The annual cost of maintaining this light and fog signal is £1,400 sterling per annum. In order to reimburse the British Treasury for this outlay, a small tonnage duty of one-twelfth of a penny sterling per ton, afterwards increased to one-eighth of a penny per ton, when the fog-whistle was established, was imposed on all vessels arriving in the United Kingdom from ports in North America, north of New York and including that port, and on vessels clearing from the United Kingdom for these ports, and with reference to vessels which entered and cleared in Canada from or to ports in Europe not in the United Kingdom, and from which the British authorities could not collect dues, Canada was required by the British Government to collect the prescribed tonnage dues and remit them to the Imperial Treasury. By doing so, however, the Canadian Government considered it would be an infringement of the principle of free lights which had been adopted in Canada, and decided to pay the dues out of the Canadian Treasury rather than collect them from the vessels. Under this arrangement, therefore, we find this strange anomaly of a foreign vessel coming to Canada for a cargo from a foreign port in Europe, and returning to a similar port with the cargo, not only using all the Canadian lights, seen during her voyage, free of charge, but the Canadian Government pays to the Imperial Treasury the dues chargeable for the maintenance of the light and fog-signal at Cape Race on account of that vessel.

Our system of free lights is not only considered to be most necessary by the commercial interests of Montreal, but for some time past the representatives of these interests have been urging the Government to abolish the canal dues, as was done recently by the State Legislature of New York, with reference to the Erie Canal, and the Government has so far yielded to these representations as to reduce the dues one-half during the present season, but the merchants and shippers of Montreal are still anxious to have the canals made entirely free, with the view of enabling the St. Lawrence route to compete successfully with the New York route, for the carrying trade of the west.

Another peculiarity of our lighthouse system may be here noticed, which differs somewhat from the systems of other countries. Our geographical position is such, that it has compelled Canada, in

the interests of her trade and navigation, to build and maintain expensive lighthouses and fog-whistles on the territories of her neighbours, free of charge, to the ships of all nations. The large island of Newfoundland, with its dangerous coast of rocks and shoals, lies immediately at the entrance of the Gulf of St. Lawrence, and vessels trading to ports in the river and Gulf must pass either to the north-west or south-east of that island, and many a good ship has come to an untimely end on its iron-bound coast, owing to fogs, snow storms, unknown currents, variation of compass, or some miscalculation or error of judgment. But as Newfoundland was not particularly interested in the efforts of Canada to secure the carrying trade of the west, or to render the route to Europe more safe and speedy than it formerly was, Canada could not reasonably ask Newfoundland to build and maintain lighthouses on its shores for the benefit of shipping trading to her ports. The only course for Canada to adopt, therefore, was to ask permission from Newfoundland to establish lighthouse stations on her shores, which would be free to the shipping of Newfoundland as well as to the vessels of all other countries which had occasion to use them. This permission was readily granted, and Canada has erected, since Confederation, a lighthouse, with a steam fog-horn attached, at Cape Ray, for the benefit of vessels entering the Gulf between Cape Breton and Newfoundland; one at Cape Bauld, with a steam fog-horn, for the benefit of vessels entering the Straits of Belle Isle; a lighthouse at Point Rich, and one at Cape Norman, also for the benefit of vessels entering by that route. It was considered very important by steam-boat owners to have this route properly lighted, as it shortens the distance from Quebec to Liverpool upwards of 200 miles, as compared with the southern route between Cape Breton and Newfoundland. It is not usually available, however, till about the 1st July, owing to the danger of meeting heavy icebergs, and even after that date the icebergs in some seasons are found in it of considerable size. Another instance occurred many years ago in New Brunswick, where the Government of that Province, previous to Confederation, wished to establish a light station on a small island or rock, belonging to the United States, called Machias Island, situated near the coast of the State of Maine, and in the track of vessels trading to St. John and other ports in the Bay of Fundy. Possession of the island was obtained, in 1832, from the United States Government for this purpose, and two powerful lights were established there, and more recently a steam fog-whistle was added to the light station. These aids to navigation, built on foreign soil, have been of the greatest possible service to United States shipping, as well as to Canadian traffic, heavy fogs frequently prevailing during the summer months on that coast.

A case occurred a few years ago in which the Canadian Government was desirous of having a new light established on Passage Island, in Lake Superior, to facilitate vessels trading to Port Arthur in connection with our rapidly increasing trade to Winnipeg and the North-West. The island belonged to the United States, and application was made by Canada to the authorities at Washington

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for permission to establish a lighthouse station there. After some correspondence they agreed to take the necessary steps to place a sum in the estimates to be submitted to their Legislature, for the purpose of erecting a lighthouse at the place referred to. We have now a very superior light on that island, with a steam fog-whistle alongside of it, which adds very much to the usefulness of the light. While the vote was under the consideration of the Legislature at Washington, a condition or rider was attached to it, viz., that the Canadian Government should erect a lighthouse on Colechester Reef, Lake Erie, a dangerous place both to Canadian and United States shipping. The condition was accepted by the Canadian Government, and tenders were invited for the work. Owing to stormy weather, however, the contractor has not been successful in laying the foundation, and he has abandoned the contract, but it is now in the hands of another contractor, and it is probable a light will be in operation there next year.

It is due to the lighthouse authorities at Washington to state that in all matters affecting the improvement of our lighthouse system I have invariably found them most courteous, and both ready and willing to give all the information in their power, as well as the benefit of the experience which they have gained in the management of the lighthouse service required to light up their extensive coasts, both in the Atlantic and Pacific, and it is scarcely necessary for me to say that they have succeeded well in the performance of their important duty, as I think it would be difficult to find better lighted coasts than those of the United States of America, in any part of the world.

A brief reference to Sable Island, which is not only one of our principal lighthouse stations but is also the principal life-saving station in the Dominion, might not be out of place here, as it has recently been brought prominently before the public notice by discussions in the newspapers, both of Canada and New York, in connection with the wreck of the Netherlands steamer "Amsterdam," which went ashore on the east bar of the island on the 31st July last, about thirteen miles eastward of the lighthouse.

The Island is situated in the Atlantic Ocean, about eighty-five miles from Whitehead Island, Nova Scotia, and about 150 miles north-east of Halifax. Although little known to the outside world, it is familiar to mariners as a long, narrow, white, sandy elevation, formed of two nearly parallel ridges, somewhat in the form of a crescent, concave to the northward, and meeting at a point at either end, with sand bars or spits running out from them a distance of some fifteen miles at the east end and probably six miles at the west end, over which the sea breaks with great fury during stormy weather. In the middle of the island and between the ridges is a narrow salt water lake, about fourteen miles long. In very heavy gales the sea sometimes washes over the land on the south side of the island into the lake, and seals, which abound on the shores of the island, have been carried over the land into the lake along with the heavy seas breaking over the beach. The continued action of the sea during stormy weather is having consider-

able effect in washing away the land at the west end, and new land appears to be gradually and steadily making on the bars at its eastern end, and vegetation is now seen where it was formerly covered by water. At the west end the sea now covers land where formerly vegetation existed. The lighthouse at the west end had recently to be moved some distance to the eastward, owing to the encroachments of the sea, which would soon have undermined it if the necessary steps for its safety had not been taken, and it is quite probable that the eastern bar is gradually extending and increasing in size, thereby rendering it every year more dangerous to shipping, which may come too close to it during foggy weather or snow storms.

The length of the island is about twenty-two miles, and it varies in breadth from a quarter of a mile to a mile. Owing to heavy fogs and snow storms, it has long been a terror to mariners, who generally try to give it a wide berth, as, in the event of a vessel striking on its beach or the treacherous bars running out from it, during a heavy sea, it is almost certain destruction.

Life saving stations are established at the east end and at the main station; and at each of these places there is a life-boat, built with proper metallic cylinders, in good repair and thoroughly efficient. In addition to the life-boats, there are surf-boats kept in readiness for any emergency, and the chief of the staff has directions to practice the men once a week. Two new life-boats of the most improved pattern are now building for these stations. At the main station is also kept a complete rocket apparatus, such as is used by the Royal National Life Boat Institution of Great Britain, in the use of which the men are practiced from time to time. A life-car is also kept at the east end station.

There are five stations on the island, and the staff, consisting of seventeen men, ~~are~~ divided as follows, viz.:—The Superintendent and six men, at the main station, about seven miles from the west end; at the west end lighthouse, the Light-keeper and his assistant; at the east end, the Lighthouse-keeper, his assistant and two boatmen; at the middle station, two boatmen; at the foot of the lake station, two boatmen. In addition to the seventeen men of the staff, there are generally two or three extra men. The staff, with their families, number about forty-six persons. No one is allowed to reside on the island unless by the authority of the Marine Department.

With reference to exaggerated statements which appeared in some of the New York papers, to the effect that the natives of Sable Island had ill-used the passengers in the "Amsterdam," and had got possession of liquor which was in the vessel, and otherwise behaved in a riotous manner, I may say that no credit should be given to such statements, as there are only a few natives on the island, and they are children under ten years of age.

Two of the men on the staff have been reported as behaving improperly on that occasion, but steps were immediately taken to suspend them and have them brought to Halifax for trial. Hitherto, in the case of wrecks, the men of the staff have been found well behaved and attentive to their duty, and as no liquor is allowed on

the island, few complaints have been brought against any of them; but in the event of liquor finding its way there from wrecked vessels, it is possible some misconduct might take place, as irregularities sometimes occur in the best regulated families, and the staff on the island is simply a large Government family, with the Superintendent at the head of it.

With reference to the complaint made by some of the passengers and crew, that it took too long time to obtain provisions for them after being landed at the lighthouse station, it may be mentioned that the principal stock of provisions is kept at the main station, fifteen miles away, the road being over heavy, soft sand, and some time must necessarily elapse before meals could be prepared, under such circumstances, for a crowd of people numbering 250. But there are plenty of provisions kept by the Government on the island, besides forty or fifty head of cattle, and upwards of 200 wild horses or ponies. It is not probable, therefore, in the event of a large number of emigrants being wrecked on the island, that they would suffer any great inconvenience for the want of provisions, and in the case of the emigrants referred to, their complaints had no substantial foundation.

During fogs and snow storms, when the whole extent of the shore of the island cannot be seen from the look-out stations, some of the men patrol the beach on horseback, at stated intervals, for the purpose of ascertaining whether any wrecks have taken place.

In 1870, a schooner was sent by the Marine Department to the island with supplies and provisions, and after delivering her cargo she left, with the view of returning to Halifax, but was never seen nor heard of afterwards. It is supposed that she either foundered or capsized, as a heavy gale sprang up after she left, but not a soul survived to tell the tale and no trace of her, or anything belonging to her, was ever found.

Although great loss of life has occurred, from time to time, on the shores or bars of the island, still many poor shipwrecked people have been assisted in their misfortunes, and have partaken of Government hospitality at some of the stations on that bleak bank of sand.

The British Government contribute annually £400 towards the maintenance of the humane establishment kept up on this island, but nothing towards the construction or maintenance of the two large lighthouses erected there in 1873. The total cost of maintaining the lighthouses and humane establishments referred to, during last fiscal year, was \$6,115.

Previous to 1873, no lights had ever been exhibited on Sable Island, as it was a disputed point for many years, as to whether the establishment of such would not be more dangerous to shipping than if there were none, the opinion being held, on the one hand, that vessels ought to give the island so wide a berth that the lights would not be visible to them, and that even if they came within sight of them, it might tend to draw them too near the sand bars in the hope of making the lights and defining their position, thereby incurring a risk and danger which might be avoided if there was no

inducement to make the island. On the other hand, it was argued that if a powerful light was placed at each end of the island, they would be visible at a distance of twenty miles or more, quite far enough to warn vessels of their danger, and to enable them to define their exact position in a dark and stormy night, when otherwise they might not be able accurately to do so.

In 1870, after I had heard many conflicting opinions on the subject, I made a visit to the island, and was not long in being convinced that powerful lights there would prove of great service to navigation, and that the high towers necessary for the lights would be serviceable in the day time as land-marks, the island being low and not easily seen at a distance. The Minister of Marine adopted the same view of this much disputed question, and but little time elapsed before Parliament had voted the necessary funds, and two large, substantial wooden lighthouse towers were erected, one at the east end, from which was exhibited a powerful dioptric light of the second order, and another on the west end, showing a powerful white revolving catoptric light, with three faces, following one after another, and then a total cessation of light, both lights being visible from all points of approach, a distance of about twenty miles. The dioptric apparatus was manufactured by Sautier, of Paris, and the revolving catoptric apparatus by Chanteloup, of Montreal. Both these lights have been of great value to navigation, and the towers, glistening in the sun during the day, can be seen a long distance off, when the island itself cannot be seen, and are as useful as day beacons, as the lights are at night.

Steam fog-whistles were also established at each lighthouse station, but, with the roar of the surf, it was found they could not be heard at a sufficient distance to warn vessels of their danger, owing to the bars running out so far from the island, and they were discontinued some years ago. An automatic whistling buoy will be placed immediately by the Marine Department, near the end of the eastern bar, to warn vessels off that dangerous place. The cost to the Government of Canada, of these two stations, including the fog-whistles, was \$70,000.

What is still wanted to make the life-saving station more efficient, is connection by telegraph cable between the island and the mainland, and telephone connection between each end of the island. When this is done, information relating to wrecks will be immediately telegraphed, and a steamer despatched to their assistance.

But little is known of the early history of this island, which lies right in the track of vessels passing between Europe and America, but as far back as 1593, we find that when the French were colonizing Acadia, this island was made a penal colony, and forty French convicts were landed there in that year by the Marquis de la Roche. It has never been very clearly established how the wild ponies or horses got there, but it is supposed by some that their progenitors got ashore from the wreck of some Spanish vessel many years ago, while others are of opinion that they came originally from Normandy, in France, with the French settlers. It has been considered advisable to allow them to remain on the



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island to the extent of 200 or 300, as, in case of an emigrant ship being wrecked there, they might prove useful as food for the emigrants, if they should fall short of provisions.

I will now refer to the system under which our lights are managed. In Canada there are thirteen members of the Government with portfolios, and one of them is the Minister of Marine and Fisheries, who is charged with the administration of all matters of a marine character, including the construction and maintenance of lights, fog-signals, buoys, beacons, the management of marine hospitals, and the care of sick, distressed and shipwrecked mariners, river police, harbour commissioners, harbor masters, pilotage, port wardens, shipping masters, examination of masters and mates, investigations into shipwrecks, rewards for saving life, life-boat service, meteorological observations, signal service, inspection of steamers, registry and measurement of shipping, public wharves, the Government steamers for attending on the lighthouses, telegraph signal service, the protection and management of the fisheries of the Dominion, and the disbursement of the fishery bounty which is voted annually by Parliament.

The business of the Department of Marine and Fisheries is divided into two branches, with a Deputy Minister for each, one embracing the lighthouses and all other marine matters, and the other all matters relating to the fisheries.

The Minister being a political officer and a member of the Cabinet, changes with the Government, but his Deputies, who manage the routine business of each branch respectively, under his directions, are permanent officials, and do not change with the Government. No practical inconvenience, therefore, ensues when a change of Government takes place, as the permanent officials are familiar with all the details, and when a new Minister takes charge, he indicates the policy which he wishes to be adopted, and they carry it out accordingly. In the Department there is a Chief Engineer, who is charged with the preparation of all plans and specifications in connection with the building of new lighthouses and the arrangement of the necessary lighting apparatus, and in each of the Provinces of Quebec, New Brunswick, Nova Scotia, Prince Edward Island and British Columbia, there is an agent of the Department to attend to its local business, as the distances are too great to admit of its being promptly attended to by the head office, and it is of such a nature that it requires continuous local supervision. The Minister submits to Parliament annually an estimate of the amount of money which he will require for the ensuing year for the maintenance of the lighthouses, the construction of such new light stations as he may recommend to be established, and all the other services of his Department.

Since the Department was organized, in 1867, when Confederation took place, up to the end of last year, 351 new lighthouses have been built and established, and the amount expended for this purpose, including the cost of providing twenty-three fog whistles and nine steam fog horns, was \$1,095,620, which would give an average of \$2,860 for each. A number of these lights were for the inland



waters and rivers, built of wood, of an inexpensive description, costing under \$1,000, which will account for the average being so small. During the current year twenty new lights will be added to the list, all of which will be in full operation before the end of the season. All the lighthouses erected by the Marine Department since Confederation have been built of wood, as it was found to be much cheaper and it required less time to build them than if they were built of stone, brick or iron.

Previous to Confederation, the lighthouses in Nova Scotia, New Brunswick and Prince Edward Island were nearly all built of wood, as being more suitable for the climate, and for the means at the disposal of the Governments of these Provinces, and some of them which have been in existence for upwards of half a century still appear to be in good condition, having been kept up in proper repair since they were built.

In Ontario and Quebec, the principal lighthouses erected previous to Confederation were heavy, strong, substantial stone or brick buildings, and will probably stand for centuries, but as compared with wooden structures, they were expensive, some of them costing upwards of \$100,000 for their construction and equipment, and were built, very nearly, after the style of those designed and erected by Stevenson, of Edinburgh, for the Commissioners of Northern Lights. The minor lights for river and inland navigation were built of wood, at a small expense, and have been found very suitable for the purposes for which they were intended.

The lighthouse which was built in 1870 on the Great Bird Rock, in the centre of the Gulf of St. Lawrence, might be taken as an illustration of the new system, as compared with the system in operation in Canada previous to Confederation. It was a place to which navigators of the Gulf and ocean steamship owners were continually referring as a locality where there was the most pressing necessity for a light, being a dangerous high rock, lying right in the track of vessels using the southern route between Europe and Quebec. Reports had been previously made by the proper officer as to its estimated cost, and all the necessary information obtained, but still, up to 1870, no light had been established there, as the construction of a stone tower on the rock would not only have been very expensive, but would have required, probably, some years to build, owing to the difficulty of landing material, with such a heavy sea breaking continually around it. In 1870 Parliament was asked for a moderate sum for the purpose of erecting a wooden tower and other buildings at this place, and it was readily voted, although fears were expressed by some of our legislators that it was too great a risk to put a wooden building there in case of fire. Plans and specifications were prepared and tenders invited, a contract was awarded, the tower was built and securely anchored to the rock, a keeper's dwelling and oil store were erected, each separate from the other and from the tower, so as to prevent, as far as possible, the risk of fire, and all the buildings well covered with iron-clad paint, a fine dioptric apparatus of the second order, made by Sautior, of Paris, placed in it, and on the 20th September, 1870,

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just four months from the time the money was voted, one of the finest lights on this continent was exhibited there, 140 feet above the level of the sea and visible a distance of about twenty miles. The cost of the buildings was \$10,000 and the apparatus about \$10,000, making altogether \$20,000. If it had been built under the previous system of stone work, the cost would probably have exceeded \$100,000. It has now been in operation fourteen years and, with good care, it may last thirty years longer. This light, along with those on the Island of Anticosti, Magdalen Islands, and our principal lights in the river and Gulf, with the exception of those on Saint Paul's Island and in the Straits of Belle Isle, have been connected with Ottawa by telegraph for some years past, so that information about wrecks, weather, and the state of the ice in the spring, is at once communicated to the Department, and to the Boards of Trade at Montreal and Quebec.

For countries possessing wealth and large populations, it is probable the system of building everything substantial and expensive, and for posterity, is the best; but for a young country like Canada, with a large territory, and extensive coasts to light up, and a comparatively small population, the cheaper system of wooden towers and effective lights is evidently the best, and most suited to the requirements of the country, as by that means we can probably build ten lights for one under the other system.

Our experience of lighthouses built on screw piles is but limited, as we have only one, and that was built on the shifting sands at the mouth of the Fraser River, in the Straits of Georgia, British Columbia, at a cost of \$21,000. The lighting apparatus is dioptric of the third order, made by Chance, of Birmingham. Some difficulty was experienced by the contractor in sinking the piles, but that was eventually remedied, and the light is now in full operation, and is described as one of the most brilliant on the Pacific coast. The extent of sea coast in the Dominion to be lighted up and provided with fog-whistles, bell buoys, automatic buoys and ordinary buoys and beacons, is 3,200 miles; inland coast, 2,600 miles, making altogether about 5,800 miles of coast to be lighted and buoyed. To effect this object, we have 308 sea coast light stations, 224 inland light stations, and 17 light ships. In the Province of Quebec, we have 146 light stations; Ontario, 139; New Brunswick, 82; Nova Scotia, 119; Prince Edward Island, 29; British Columbia, 7. The light ships are divided as follows:—Quebec, 8; Ontario division, 5; New Brunswick, 2; Nova Scotia, 1, and one at the mouth of the Red River, in Manitoba. Three of them are strong, English-built, iron vessels, having powerful steam fog-whistles on board, and are stationed in the lower St. Lawrence, below Quebec.

The system adopted in Canada for the construction of new light-house stations is by contract, public notice being first issued, inviting tenders for the work, on plans and specifications prepared by the Engineer of the Department; and when the tenders have been received, the contract is invariably awarded to the person making the lowest tender, if he is prepared to go on with the work. The contracts have generally been taken at low prices.

New light stations are generally established on the representations of seafaring men. Members of Parliament representing maritime districts, and possessing local knowledge, have also much influence in the establishment of such stations. When representations have been made to the Minister of Marine, urging the necessity of a new light in some particular locality, an investigation is made by the Department, and the opinion of its practical officers obtained as to the necessity for the proposed light, with reference to the dangers of navigation and the amount of traffic to be served. The Minister then decides as to the merits of the case, and if satisfied that it is necessary and in the public interests, he places it in the list of new lights proposed to be built during the ensuing year, which he submits to Parliament, with his recommendation that the necessary funds be provided; and as soon as the vote has passed, arrangements are at once made for securing a site and proceeding with the work.

Nearly all the leading lights in the lower St. Lawrence, the Gulf and the Straits of Belleisle, which have been established since 1867, had no particular political influence to urge their construction, but were established on the recommendation of ocean steamship proprietors and their most experienced captains, and the Boards of Trade of Montreal and Quebec, who took much interest in this matter.

Prominent among the representatives of the ocean steamship interests, was the late Sir Hugh Allan, one of the principal owners of the Montreal Ocean Steamship Company, who never ceased during his lifetime, to take a deep interest in the question of lighting the lower St. Lawrence and the Straits, and who had much influence as a prominent ship owner with every Minister of Marine, in making recommendations as to the improvement of the route to Europe. The lighthouse and fog-whistle station at Cape Bauld, at the entrance of the Straits of Belleisle, was the last one which he urged on the notice of the Minister, as being necessary to render the lighting of the route efficient, and this station has just been completed and is now in full operation.

The ocean steamship interests are much indebted to the Honorable Peter Mitchell, who was appointed Minister of Marine and Fisheries in 1867, when Confederation took place, and held the office till 1873, for many of the improvements in the lighthouse system of Canada, and for the establishment of a number of new lights in the River and Gulf of Saint Lawrence, as well as in other parts of the Dominion.

The steam fog-whistles in use in Canada may be considered a part of our lighthouse system, and have been found to give good results. They are valued, on some parts of our coast, where fog prevails in the summer and snow storms in the winter, quite as much as the lighthouses. The machine in use is simply a multitubular boiler, with a small engine attached, for opening the valve and regulating the blasts of steam, at stated intervals, as desired. The blast can be distinctly heard, under ordinary circumstances, from four to ten miles distant, according to the state of the atmosphere, but on some particular occasions it has been heard as far as thirty miles distant.

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The whistle at the top of the escape pipe for the steam is usually 10 inches diameter and 1 foot 6 inches high. The cost of the steam fog-whistles, without the buildings, tanks or water arrangements, is about \$2,000, but the consumption of coal is necessarily great, and a plentiful supply of water is required. Owing to the expense of keeping this description of fog alarm in operation, the Department has not erected any new ones of late years. The description of fog-horn, which has recently been adopted, is the Champion automatic fog horn, and it requires very little fuel and water, and has given satisfaction. The sound is produced by compressed air passing through the horn, instead of steam. The machine consists of a tubular boiler, 5 feet 6 inches high, 2 feet 9 inches diameter, a large air cylinder 3 feet 8 inches diameter, 3 feet 10 inches long, to which is attached a horn, carrying a powerful reed, and a steam cylinder 2 feet diameter, with an automatic apparatus for the control of the supply of steam. Its action is as follows: Steam being turned on, enters the steam cylinder and causes a piston to ascend; attached to this piston, by means of their common piston-rod, is another piston working in the air cylinder, which is supported above the steam cylinder by means of four columns attached to the bed plate. By this means the air contained in the upper cylinder is forced through the reed, the tongue of which is of steel, 8 inches long, 2 inches wide and  $\frac{5}{16}$  of an inch thick, causing it to vibrate rapidly, and thus emit a powerful sound. When the pistons approach the top of their stroke, the lower one, by a very simple contrivance, closes the supply valve and opens the exhaust valve, which allows the expended steam to escape, consequently the pistons, by their own weight, gradually descend, thus allowing the air cylinder to fill with air again. When the pistons reach the bottom of their stroke, the upper one reverses the movement of the valves, when the above operations are automatically repeated *ad libitum*. By means of an adjustable valve on the exhaust pipe, the intervals between the blasts can be closely adjusted. The amount charged for these machines by the patentee is \$2,000, but they can be made by competition for \$1,000 each, when a number are taken. They are well suited for localities where it is difficult and expensive to provide fuel and water, but it is doubtful if their sound could be heard at as great a distance as that of the steam whistle. We have nine automatic fog-alarms in use, and the Department is now about to establish twelve more in different parts of the Dominion where fog frequently prevails.

The Courtney automatic whistling-buoy, of which we have eight in Canadian waters, is a recent American invention, and has been found to be of great service to shipping, in connection with our lighthouse system. It is of no use in completely smooth water, without any swell, but requires considerable rolling sea to make it work effectively, and under such circumstances, it emits a loud blast, similar to a compressed air fog-horn worked by steam. The large sized buoy is 10 feet in diameter, and has a hollow iron cylinder about 30 feet long, open at the lower end underneath it, which is filled with water, and as the buoy goes up and down on the

waves, the water in the cylinder being stationary, it compresses the air at the top of the cylinder and drives it through the whistle above the buoy, thereby making the blast. This description of buoy cannot be used in shallow water, but is intended to be moored some distance away from the shoal or danger to be avoided. The cost of this buoy is \$1,575 in New York, without the ground tackle. We are now having two made, one to be anchored off the end of the eastern bar at Sable Island, and the other off Point Lepreau, in the Bay of Fundy.

A new description of buoy, with a gas light arranged in a frame on the top of it, enclosed in a small dioptric apparatus or Fresnel lens, has recently been used by the Trinity House of London and by the Commissioners for managing and lighting the Clyde, in Scotland, with good results. The gas is made specially for the buoys from petroleum oil, and is compressed into an iron cylinder, when about to be transferred to the buoys, and when a buoy of the largest size is properly charged with this compressed gas, it should burn day and night for ninety days, without requiring any attendance. Two of these buoys, with the necessary gas works to be erected at Quebec, have been ordered through the Trinity House, London, and will be placed immediately in the Lower St. Lawrence. If found to work successfully, they may possibly take the place of small lighthouses or lightships. They can be seen a distance of seven miles. The cost of the buoys, with a bell attachment, to warn vessels of their locality, will be \$3,750 each, and the cost of the gas works, with store holder, will be \$3,500. The arrangement of the lantern is such, that while the necessary air is admitted to feed the flame, no water can enter, no matter how high or violent the sea.

The Department is always ready to adopt any new improvement or invention which may be discovered in connection with the light-house service, after it has been thoroughly tested and pronounced to be efficient and successful.

The bell-buoys used are now made in Canada, by contract, similar to the bell-buoys of the Trinity House, London, and are made of boiler plate iron, with compartments and water ballast, the cost of which is about \$1,000.

The lighting apparatus in use in the lighthouses of Canada is very much the same as in other countries, viz., catoptric and dioptric. For our large important stations, having revolving lights, the catoptric apparatus is used. It consists of powerful lamps connected with flat oil receivers at the back of the reflectors. At the back of the lamps are parabolic silvered reflectors, varying in size from 18 to 24 inches in diameter, for the purpose of reflecting the rays, and throwing them out in a certain direction. A number of these lamps, with reflectors fitted to them, say three, four or five, are fixed to the sides of an iron frame, having two, three or four sides, and the whole made to revolve with clock work machinery and heavy weights. If the light is required to show, say, every three minutes, two faces will be found sufficient if oftener, three or four faces may be used, as the case may be. The

reflectors on each face or side of the revolving frame are thus successively directed to every point of the horizon, and the combined result of their rays form a flash of greater or less duration, according to the rapidity of their revolution, the light gradually increasing till it attains its full power, and then gradually diminishing, till it becomes invisible. As regards the distance one of our powerful revolving catoptric lights can be seen, it is only limited by the horizon, and with an ordinary high tower, the light being about 100 feet above the level of the sea, it should be visible on a clear, dark night, nearly twenty miles distant.

If lights are placed at too high an elevation, there is some risk of their being obscured by clouds or mist, while the land, lower down, may be quite visible. This was the case at Belleisle, near the entrance of the Straits, where there is a first order dioptric light placed at an elevation of 470 feet above the level of the sea at high water mark, but it was frequently obscured by clouds, while the land and breakers below could be easily seen. To remedy this difficulty, another light was erected on the rocks nearer the edge of the water, and this minor catoptric light can be sometimes seen when the large dioptric light above is invisible.

At some of our large catoptric lights we have as many as eighteen or twenty lamps, which not only consume a considerable quantity of oil but create much heat, causing danger of explosion if the oil was not specially prepared for the service. One great objection to catoptric lights, as compared with dioptric, is the large consumption of oil required for so many lamps, whereas in the dioptric apparatus only one lamp is necessary. We have 483 lights in the Dominion, the apparatus of which is on the catoptric principle, and as all the lamps and reflectors for these lights are manufactured in this country at a much less cost than dioptric apparatus can be imported from England, it has been found advisable to use this kind for all our revolving lights and fixed lights of a minor character.

The dioptric apparatus is used at some of our great sea lights, such as Sable Island, Belleisle, Point Amour, Cape Rosier, Bird Rock, Sambro Island and Seal Island, where the lights are fixed white, and they were manufactured either by Sautier, of Paris, or Chance, of Birmingham. A dioptric is made of cut crystals or prisms, highly polished, and the large sizes, such as first or second order, are very expensive. Only one lamp is used, with concentric wicks, numbering from one to four or five, according to the size of the apparatus, and from this is emitted luminous beams in every direction. The lamp is placed in the centre of the crystal apparatus, with an oil receiver so arranged as to keep a constant supply of oil up to the flame without obscuring any portion of the light. In the case of the dioptric or lens system, the controlling apparatus which gives brilliancy to the light is placed before it instead of behind it, as in the case of the catoptric apparatus. This arrangement of crystals surrounding the lamp is so formed as to refract the beams of light from the lamp into parallel rays in the required directions. The lamp requires careful, constant, attentive watching by trained keepers, in order to regulate the size of the



flame of each of the wicks, and it should never be left without an attendant when it is in operation. The mammoth flat wick lamp in use in nearly all our catoptric apparatus has given the best results and does not require continuous watching, and therefore is much better suited for our Canadian lights, which are maintained at a small expense, and are, as a rule, only supplied with one keeper. There are sixty-six dioptric lights in the Dominion, two of which are of the first order, twelve of the second order and six of the third order. The cost of a first-class revolving catoptric apparatus, made in this country, with a 12 feet iron lantern, is about \$2,913. The cost of a first-class fixed white dioptric apparatus, with lantern and lamps complete, made in England, is about \$14,800; but for complicated flashing lights, they reach as high as \$22,350.

The illuminant used in the Canadian lighthouse service is petroleum of Canadian production and manufacture, and is required to be of the best quality, double distilled, standard white, extra refined, free from acids or other impurities, to weigh, at 62° Fahr., not less than 7.85 lbs., nor more than 8.02 lbs. per gallon; to withstand a flash test of 115° Fahr. by the new standard pyrometer. In burning for twelve hours, the oil must produce a brilliant and nearly uniform flame, without crusting the wick or discoloring the chimney, and with a loss of not more than 15 per cent. in power during that period. About 100,000 gallons per annum are required for the service, and tenders were invited last winter for a supply for three years. The contract was awarded to the Imperial Oil Company, of London, Ontario, at 20 cents per imperial gallon, delivered at Hamilton or Goderich, and the oil delivered this season has been up to the standard quality.

With oil at such a low price, the quantity consumed becomes of very little consequence, and therefore the catoptric system, which consumes very much more than the dioptric, is the best suited for our requirements, as the cost of catoptric apparatus is very much less in the first instance than of dioptric.

The number of light stations in Canada with fixed lights is 467, and with revolving lights eighty-two, making altogether 549 light stations on the 31st December, 1883. The number of persons employed by the Government to attend to these lights is 656, and the salaries paid to them range all the way from \$80 for small river lights, up to \$1,500 per annum. The latter mentioned sum is paid to the keeper of Bird Rock light, who has also to fire a signal gun during foggy weather. He is required to keep two assistants, and he feeds them and pays them wages out of the salary allowed him: The situation is by no means an enviable one, as the keepers must remain on the rock all winter, and as it is high out of the water, with a small flat surface, they must exercise great caution while moving about, as it is usually covered with ice during the winter months. When the wind is high, they sometimes find it necessary to go from one building to another on their hands and knees, to avoid being blown off into the sea.

The salary usually allowed the keeper of a sea coast light is between \$300 and \$500, and there are often many applicants for

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any vacancy. The salaries of keepers of river and harbour lights are small, as they generally have opportunities of adding to their income by farming, fishing or some other occupation, in their immediate neighborhood. At stations where an assistant is necessary, the salary of the keeper is increased to enable him to hire one, but the Government does not appoint him or recognize him in any way. The duly appointed keeper is held responsible for the proper performance of the duty.

Before recommending a person to His Excellency in Council for the position of light-keeper, the Minister of Marine usually consults the member of Parliament for the county or district in which the vacancy has occurred (if he is a supporter of the Government), and obtains his recommendation of a suitable person for the appointment. There is no system of promotion among the keepers, and it is understood that the appointments are usually made through political influence. The salaries of some of the keepers are occasionally increased, on account of length of service, good conduct, additional work being imposed on them, or their salaries being too small, but they are rarely moved from one place to another, in the way of promotion.

Taking the light-keepers as a body, they are a very intelligent, useful and respectable class of persons, and, as a rule, perform their duties very satisfactorily, although the remuneration is exceedingly moderate. The plan of selecting them also works well, as the member who has the responsibility of nominating a keeper, is generally careful to recommend a good, reliable man, who may be trusted with the management of the light, seeing that the safety of life and property frequently depends on his attention to duty.

The expansion of the lighthouse system of Canada during the last seventeen years has been great. In 1867, when the four Provinces were confederated, there were 198 light stations in the Dominion and two fog whistles, and at the close of this season there will be 569 light stations, thirty-six fog-alarms and ten automatic whistling-buoys in operation.

As compared with the lighthouse systems of the United Kingdom and the United States, our lights, although very good and suitable for our trade, are not of such a high class, and have cost much less to build and maintain than those of the countries referred to, but in both of these countries ship-owners have not been so much favored as in this country, where shipping contributes nothing to the support of the lighthouses.

In the United Kingdom the light dues collected in the year 1883-84 for all general lights managed by the Trinity House, London, the Commissioners of Northern Lights, and the Commissioners of Irish Lights, was £476,116 sterling, equal to about \$2,380,580, while the tonnage dues collected from shipping in the United States, although not nominally for light dues, was, as already shown, \$1,320,590. In England, the Trinity House has the management of the general lights, for which light dues are collected, and that honorable and ancient corporation may be considered as the lighthouse authority



of the world, and amongst their officers are gentlemen of high scientific attainments and great experience.

The Marine Department of Canada has been under many obligations to the officers of this corporation for advice and assistance, which have always been most readily and freely given.

The Trinity House has under its management sixty-five light stations with dioptric lights, twenty-one with catoptric lights, and forty-six light vessels with catoptric lights, making altogether 132 light stations.

In Scotland the general lighthouse authority is the Commissioners of Northern Lights, who have under their charge forty-five light stations with dioptric lights, thirteen with catoptric lights, and ten catadioptric, making sixty-eight light stations in all.

In Ireland the general lighthouse authority is the Commissioners of Irish Lights, who have under their jurisdiction thirty-five stations with dioptric lights, forty-one with catoptric lights, and twelve light vessels with catoptric lights, making eighty-eight in all.

The three lighthouse authorities who have the management of the general lighthouses for which light dues are collected in the United Kingdom, have therefore under their jurisdiction 288 light stations.

In addition to these lights, however, there are a number of local harbor lights of a minor description, which are maintained by local authorities, such as Harbor or Dock Commissioners, and these will probably number about 140, making altogether about 428 lights, large and small, on the coasts of the United Kingdom, with a coast line of about 3,500 nautical miles.

The cost of maintaining the 288 light stations under the jurisdiction of the three corporations referred to, including the maintenance of steamers and supply vessels, during the year ended 31st March, 1883, but not including the cost of collecting light dues, superannuation of officers, or works in connection with building new lighthouses, was £303,830, equal to an average of about £1,054 for each, or about \$5,270.

In the United States the general lights are managed by a Light-house Board, with two official secretaries, one an officer of the army and the other an officer of the navy. This Board has under its management 746 light stations, with dioptric lights, and thirty-two stations with catoptric lights. There are besides these 1,049 minor lights, established on western rivers, that cannot strictly be placed in either of the above classes. There are also thirty light vessels, making altogether 1,857 lights in the United States, large and small, with a sea coast line to be lighted, roughly estimated at 12,600 miles; inland coast, roughly estimated at 3,000 miles, and length of rivers to be lighted, roughly estimated at 4,000 miles, making altogether about 19,600 miles of sea and inland coast and rivers to be lighted.

The total cost of maintenance of all these light stations, light vessels, buoys and beacons, steamers attending on lights, &c., for the year 1883, was about \$2,000,000. If the small lights on the western rivers are included, these figures would give an average cost of their lights at \$1,077 for their maintenance.

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In Norway there are 132 lights maintained by the Government which cost \$157,000, equal to an average cost of about \$1,189 for each. The lights in Norway are maintained by light dues on shipping.

The average cost of maintaining our Canadian lights, large and small, including the cost of maintaining four steamers to attend on them, and the buoys and beacons of the Dominion, is about \$1,000 each per annum.

It will be readily understood from the foregoing statements relative to the expansion of our lighthouse system, that the Government of Canada has done much, since the confederation of the Provinces, to improve the system of lighting up the coasts of the Dominion and providing fog-signals, for the purpose of rendering the navigation of our waters as safe as possible. A vessel may now navigate from Lake Superior to Halifax, and can scarcely be out of sight of some one or other of the numerous lights which will guide her on her voyage through the inland seas, rivers and Gulf of St. Lawrence to her port of destination. Between Montreal and Quebec a large passenger traffic is carried on by night boats during the season of navigation, and an accident to these boats, which are the admiration of travellers, is almost unknown. The system of leading lights, for this portion of our great river, has been much admired by nautical men, who have travelled in these boats and have watched their navigation during the night. The shoals are numerous, and the channel in some places intricate, but by the excellent system of range lights and careful steering of skilled pilots, these boats, loaded with passengers, pass up and down every night during the season of navigation, and keep up to time with the regularity of a railway train, and with the comforts of a good hotel.

In 1872, long before our lighthouse system had risen to its present state of efficiency, a Committee of the Trinity House, London, visited this country and the United States, with the object of examining the fog-signals in use on this continent, and acquainting themselves with the working of the lighthouse system in the two countries. On their return to London, they reported most favorably of our lighthouse system, both as to its economy and efficiency.

They referred to the lights which they saw in the Gulf and River of St. Lawrence, as being very efficient, showing well a bright light a long distance off, and they alluded to those they visited as being scrupulously clean and in good order. With reference to the lights on Lake Ontario, which they saw while steaming up the lake, they stated that they were observed, clear and strong, at a distance of fifteen miles, and that the strength and efficiency of all the Canadian lights which they saw, struck the committee forcibly as indicating the high value of the illuminant used, and they characterized the Canadian system as one of simplicity and economy, admirably adapted for a young country, and that a higher ratio of illuminating power was obtained from our mineral oil in catoptric lights than in any other arrangement; and with reference to our

fog-signal system, they stated that while simplicity and economy were also the ruling influences in connection therewith, it was good and effective, and had been of great benefit to the trade.

Such was the testimony, in 1872, of these able and disinterested gentlemen of experience, as to the system of lighthouses and fog-signals then in operation in the Dominion of Canada, and since that time great improvements have been made on our coasts, both as regards the number and efficiency of our lights and fog-signals.

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## MEMORANDUM.

Since the foregoing paper was prepared, a copy of the Shipping Act recently passed by the United States Legislature has been received. With reference to the tonnage tax formerly imposed on shipping entering the ports of the United States from foreign countries alluded to on page four, the new Act provides, that in lieu of the old tax on tonnage of thirty cents per ton per annum, a duty of three cents per ton, not to exceed in the aggregate fifteen cents per ton in any one year, is imposed at each entry on all vessels which shall be entered in any port of the United States from any foreign port or place in North America, Central America, the West India Islands, the Bahama Islands, the Bermuda Islands, the Sandwich Islands, or Newfoundland; and a duty of six cents per ton, not to exceed thirty cents per ton per annum is imposed at each entry upon all vessels which shall be entered in the United States from any other foreign ports; Provided, that the President of the United States shall suspend the collection of so much of the duty imposed on vessels entered from any port in the Dominion of Canada, Newfoundland, the Bahama Islands, the Bermuda Islands, the West India Islands, Mexico, and Central America down to and including Aspinwall and Panama, as may be in excess of the tonnage and light house dues, or other equivalent tax or taxes, imposed on American vessels by the Government of the foreign country in which such port is situated, and shall upon the passage of the New Act and from time to time thereafter, as often as it may become necessary by reason of changes in the laws of the foreign countries above mentioned, indicate by proclamation, the ports to which such suspension shall apply, and the rate or rates of tonnage duty, if any, to be collected under such suspension. Vessels which have paid the old tonnage tax for the current year shall not be liable to the new tax until the expiration of the certificate of last payment of the old tax.

The Acts which formerly provided for the assessment and collection of a hospital tax for seamen in the United States, are also repealed, and the expense of maintaining the Marine Hospital service shall hereafter be borne out of the receipts for duties on tonnage provided for, under the New Act.

There being no light dues in Canada, and only a small tonnage tax imposed on vessels entering the Maritime Provinces for the maintenance of Marine Hospitals and sick seamen, and on vessels entering the ports of Montreal and Quebec for the maintenance of a Harbour police force, vessels entering ports in the United States from ports in Canada, will now be admitted on the payment of a duty equal in amount to the tonnage dues imposed on vessels entering Canadian ports from the United States.

