REPORT

OF THE

DEPARTMENT OF THE NAVAL SERVICE

FOR THE

FISCAL YEAR ENDING MARCH 31, 1917

PRINTED BY ORDER OF PARLIAMENT

OTTAWA
J. DE LABROQUERIE TACHÉ
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1917

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To His Excellency the Duke of Devonshire, K.G., P.C., G.C.M.G., G.C.V.O., etc., etc.. Governor General and Commander in Chief of the Dominion of Canada.

MAY IT PLEASE YOUR EXCELLENCY:

I have the honour to submit herewith for the information of Your Excellency and the Parliament of Canada, the Seventh Annual Report of the Department of the Naval Service, being for the year ended March 31, 1917, except the Fisheries Branch, reported in a separate publication.

I have the honour to be,

Your Excellency's most obedient servant,

J. D. HAZEN,
Minister of the Naval Service.

CONTENTS.

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OTTAWA, September 25, 1917.

Hon. J. D. HAZEN,
Minister of the Naval Service,
Ottawa, Ont.

SIR,—I have the honour to report on the Department of the Naval Service for the year ending March 31, 1917, under the following headings:—

1. Naval Service.
2. Survey of Tides and Currents.
3. Hydrographic Survey.
4. Canadian Arctic Expedition.
5. Radio Telegraphs.
6. Fisheries Protection.
7. Life Saving Service.
8. Stores.
9. Expenditures.

1. NAVAL SERVICE.

H.M.C. NAVY.

During the past year the requisite number of personnel for manning H.M.C. Ships and Establishments has been maintained by the entry of men with previous naval experience, and by the employment of Royal Naval Canadian Volunteer Reserve officers and men.

H.M.C.S. *Niobe* is still utilized at Halifax as a depot ship, and also acts as parent ship for patrol vessels based on Halifax.

H.M.C.S. *Rainbow*, as well as submarines *C.C. I*, *C.C. II* and their parent ship *Shearwater*, have been continuously employed on the west coast on important duties in connection with war operations. All these vessels have been under orders of the Imperial Senior Naval Officer at Esquimalt.

A large number of other vessels, both Government and private, have been utilized, particularly on the east coast, in connection with the naval defence, mine-sweeping, patrols, examination service, and other necessary work.

The Canadian Coast Patrol, recently established, has been placed under direction of Commodore Sir Charles H. Coke, K.C.V.O., lent to the Canadian Navy from the Imperial Government. He acts under orders from this department.

The Royal Naval Canadian Volunteer Reserve officers and men continue to do valuable work ashore and afloat in H.M.C. Ships and Establishments, on both the Atlantic and Pacific coasts.

NAVAL DOCKYARDS.

With respect to the Naval dockyards, both establishments have been worked to the full output, a considerable amount of overtime having been worked. The nature of the work done has been practically all repairs.

Halifax is being used as the base for vessels of the North Atlantic fleet which has been lately strengthened; the dockyard is being used for carrying out repairs to these vessels and keeping them in going order.

At Esquimalt yard work has been carried out on Imperial vessels, as well as those of the Canadian service. The floating dock at Prince Rupert has been assembled under great difficulties, and three large armed auxiliary cruisers have been docked and put in a state of repair, after having been badly damaged by grounding.

The total amount of money paid per month in wages for the two yards is approximately 400 per cent more than that customary to be paid for the same period prior to the war.

In addition to the repairs to the vessels of the fighting fleet, the dockyards are carrying out the large number of small items of repairs needed to the various vessels now employed for auxiliary purposes for patrol and other defensive work of the coasts.

The number of patrol vessels has been materially increased during the past four months. Alterations have had to be made in these vessels to adapt them for patrol service.

Having regard to the facilities available, this work has been carried out satisfactorily. Considerable overtime has been necessary in order to expedite the completion of the repairs.

Subsidiary work in the nature of repairs and refits of the various vessels belonging to the different branches of the Naval Service have been undertaken during the year, and repairs of vessels of other departments of the Government have also been effected. Repairs to buildings and plant incidental to the up-keep of the establishment in accordance with conditions of transfer have also been completed.

NAVAL STAFF OFFICE.

The Naval Staff Office has continued to carry on its work in a satisfactory manner. The work of this branch of the service is continually increasing in importance.

ROYAL NAVAL COLLEGE.

The cadets in the college and the midshipmen at sea, in both Canadian and Imperial ships, continue to be well reported upon and to give satisfaction to their superior officers. Fourteen cadets were entered after the cadetship entry examination in May, 1916.

The fourteen midshipmen who entered the College in January, 1911, have been promoted to Acting Lieutenant. All these officers are now serving in the Royal Navy.

RECRUITING.

The Dominion Government offered to place at the disposal of the Admiralty a number of men belonging to the Royal Naval Canadian Volunteer Reserve, which offer was accepted by the Imperial Authorities.

An Overseas Division of the R.N.C.V.R. was accordingly established and recruiting offices were opened throughout Canada, to enter men in that division of the service. A provincial committee was appointed for each province, under which sub-committees were organized at the principal centres; each committee was provided with a paid secretary. The sub-committees were responsible to the provincial committee, which, in turn, was responsible to the Department of the Naval Service.

The members of all the different committees gave their services gratuitously, and they spared no efforts to advance the work of recruiting. The department wishes to express its appreciation for the valuable work done by the members of these committees.

Recruiting commenced in the fall of 1916. Up to the 31st March, 1917, 1,331 men were entered in the R.N.C.V.R. Overseas Division for service in the Royal Navy, of whom 1,188 have been sent overseas.

These men receive the same rates of pay as men of the same standing in the Royal Canadian Navy. They are actually paid the same rates as men of their standing in the Royal Navy whilst they are serving in Imperial ships, the difference between their Imperial and Canadian pay being placed to their credit, payable to them upon their discharge from the R.N.C.V.R. or their return to Canada, or paid to their dependents.

Commander F. P. Armstrong, with a recruiting committee, came to Canada in April, 1916, to recruit for the Royal Naval Volunteer Reserve Auxiliary Patrol (Motor Boat) Service; 264 Sub-Lieutenants, 52 chief motor mechanics, and 60 motor mechanics were entered by Commander Armstrong up to the 30th August, 1916, when recruiting was discontinued. Recruiting for this service was carried out by the Imperial Authorities.

The department has continued to enter officers for the Royal Naval Air Service. Up to the end of the fiscal year 1916-17, 382 officers have been entered. Since the 20th July, 1916, candidates have not been required to obtain their Aero Club certificates before proceeding to England.

The report of Admiral C. E. Kingsmill, on the Naval Service, may be found at page 1.

2. TIDAL AND CURRENT SURVEY.

The work of this Survey has been satisfactorily conducted throughout the past year. Tidal observations were carried on at some stations during the summer months and at others during the whole year. The determination of mean sea-level was also carried forward at many points on the east and west coast, and the investigation of currents in the different passes begun in previous years was continued and new work of a similar nature was undertaken in several other passes, particularly on the west coast.

Six principal tide stations on the east coast and five on the west coast were operated during the whole year. A number of subsidiary stations were operated during the summer on both coasts. From the reduction of the observations taken at these stations, tidal constants are obtained upon which predictions of tides for publication in the tide tables are made. By extending the scope of these stations, greater accuracy for the time of the tides over an ever-increasing area of navigable waters is being obtained.

The improvement of the tidal records for the Pacific coast was given special attention last year, as a result of which the tide tables for Port Simpson, Prince Rupert, and Vancouver, as well as for the navigable passes of the west coast will be rendered much more accurate.

As the lighthouse at Sand Heads was replaced by a lightship it became necessary to close down the tidal station there, which hitherto had been used as a base for calculations in the strait of Georgia, and had been operated by the lighthouse-keeper. A new station at point Atkinson in the strait of Georgia, which is found to correspond to Sand Heads, was opened and has proved a satisfactory substitute for the former base. The observations taken will enable the earlier records from Sand Heads to be enlarged upon and improved. New stations were also established at the north end of the strait of Georgia and at points opposite the north end of Vancouver island. The object of these stations is to obtain further observations as a basis for the revision of the tidal data for that region.

On the east coast, new tidal observations were taken at the head of the bay of Fundy and along the north coast of Prince Edward island. The results obtained in the bay of Fundy were compared with simultaneous observations taken at St. John, N.B., and the complete results of the work will be published in a special report entitled, "Tides at the head of the bay of Fundy".

On Prince Edward island tide gauges were operated at Tignish, Alberton, Malpeque, Rustico, St. Peters, and Naufrage. The tide in this region is of a special nature as there are times when only one high water and one low water in the day are pronounced. The observations taken at the above-mentioned places were compared with the St. Paul island station, and the results as well as an explanation of the peculiarities of the tide will be given in the tide tables for 1918. This information will be valuable in determining the nature of the tides in the lower half of the gulf of St. Lawrence. It will also be of great assistance to the mariners desiring to seek shelter in the various ports along the coast in bad weather.

Through co-operation with the Hydrographic Survey, tidal observations were obtained for further points on the lower St. Lawrence at Grand Mechins and Godbout. These observations will be useful to connect previous records for the gulf of St. Lawrence with the St. Lawrence river.

The work of investigating the currents of the gut of Canso, begun in 1915, was continued during the summer of 1916. The behaviour of the current as thus ascertained is fully explained in the report of the Tidal and Current Survey appended hereto, and in the 1918 tide tables.

On the west coast, the method of calculating slack water in Seymour narrows was greatly improved. Previously these calculations were made on a very intricate and technical basis. With the new method, equally accurate results are obtained and the possibility of error in calculation is greatly eliminated. Improvements in the calculations for Active pass were also made, as well as for Porlier pass and for Wellbore channel.

All the information obtained with reference to these passes, besides serving the purposes of navigation in general, are valuable to the coal transportation and lumber interests operating in the localities. The information which enables these commercial interests to know the variations of tides and currents, the exact time when passes and river entrances are navigable, and the direction and force of the currents, is essential to them. This information is published in the tide tables and in pamphlets. For the convenience of commercial establishments, it is also supplied to them upon request, prior to its regular publication in the tide tables, etc., thus supplying them with advance information.

In Hudson bay and in James bay, the tidal observations taken closely correspond with the predictions already made, which proves that the method employed is closely accurate. The information will be useful to any business interests operating there, as well as to the Hudson bay railway in connection with its terminals.

Considerable work was done to reduce the observations taken by members of the Canadian Arctic Expedition at different points in the Arctic. The results will add substantially to our knowledge of the tide in these regions, although the rise of the tide is very small in the waters explored.

The determination of mean sea-level carried on by this survey at the principal tide stations has proven very useful to the Public Works department in connection with their geodetic work. By connecting the tide levels referred to the bench-marks of the survey as well as to the Admiralty bench-marks results published by that department have been greatly enhanced.

By reference to these bench-marks the Dominion Observatory have also obtained a reliable basis for their extended levels, references being available at Halifax, Yarmouth, and Vancouver. The departments of Railways and Canals and Public Works have also been supplied with information on tide levels and extreme tides in connection with the various railway construction works being carried out.

The complete information obtained from the various activities of this branch is published annually in the tide tables and in a series of reports on currents. A summary of operations for the year, is given in the report of the Superintendent of the Tidal and Current survey at page 3.

3. HYDROGRAPHIC SURVEY.

The duties of the Hydrographic Survey are to investigate the different navigable waters in Canada, to take soundings of and chart the different courses through the rivers and along the coasts, and to survey and chart the different harbours and harbour entrances.

During the past year seven parties were engaged in carrying on the different surveys.

HALIFAX HARBOUR, ETC.

A party under Captain Anderson, in the steamer *Acadia*, were employed in re-sounding the approach to Halifax harbour and the area off the coast between Egg island and Pennant point. All the main shoals marked on Admiralty chart were re-examined; some of these shoals had less water over them than shown on the charts, while others marked on the charts could not be located. Notices to Mariners giving the results of the work have been published.

The main triangulation of 1916 was extended to the northeastward as far as Liscomb harbour, and to the southeastward as far as Port Medway.

BEDFORD BASIN AND LOCKPORT HARBOUR.

Bedford basin was re-surveyed and a new chart of it is under preparation. Lockport harbour was also examined, and new shoals located at its entrance.

Observations for magnetic declination were taken at important points along the coast.

On the 24th November, the *Acadia* having been laid up, the staff returned to Ottawa.

New charts for Bedford basin and for that part of the coast from Egg island to Pennant point, including Halifax harbour, will be published at an early date.

PACIFIC COAST SURVEY.

The Pacific Coast Survey party, in charge of Lieut.-Commander P. C. Musgrave, in C.G.S. *Lillooet*, set out from Esquimalt on the 10th April.

The season's operations were carried out in the vicinity of Queen Charlotte islands. On the way north an examination of Retreat cove in Trincomali channel and of Millbank sound was carried out.

Additional surveying of Alice arm was carried out between the 26th April and the 27 May, when the ship proceeded on her regular work at Queen Charlotte islands.

In June, soundings were taken in the west aproach to Dixon entrance, and work was then proceeded with in Hecate strait and near Queen Charlotte city.

In October the party returned to Alice arm, where the survey of the inlet was completed.

During the season an examination of Skidgate channel was also made.

The party returned to Esquimalt, where the *Lillooet* was laid up on the 4th November.

Valuable assistance was received from the Geodetic Survey, which supplied astronomical positions as groundwork for the Hydrographic Survey charts.

LOWER ST. LAWRENCE.

The Lower St. Lawrence Survey party, in charge of Mr. Charles Savary, in C.G.S. *Cartier*, continued the main triangulation of the south shore of the St. Lawrence as far east as Marten river, and on the north shore as far as Egg Island lighthouse.

As a result of the season's work, a new chart, taking in both shores of the St. Lawrence river, entitled "Pointe Des Monts to Father Point" will be published shortly.

The survey terminated early in November.

LAKE SUPERIOR PARTY NO. 1.

Mr. H. D. Parizeau, in C.G.S. *La Canadienne*, set out for Nipigon bay on the 4th May. A survey of this bay was carried on until the 13th September, when the party moved to Black bay. In entering Black bay the vessel ran aground and was badly injured. She was placed in the dry dock at Port Arthur, where repairs were carried out. As by the time the vessel was repaired the season was too far advanced to return to Black bay, the party worked in the vicinity of Port Arthur and Fort William until the 21st October. They then proceeded to Owen Sound, where the vessel was laid up for the winter.

As a result of the season's work, a chart of Nipigon bay will be published shortly.

LAKE SUPERIOR PARTY NO. 2.

Mr. G. A. Bachand, in C.G.S. *Bayfield* carried on work from Otter Head eastward along the shore in connection with the Michipicoten survey. They continued work in this vicinity until the 25th October, when bad weather obliged them to discontinue work for the season. They then returned to Owen Sound, where the vessel was laid up.

A new chart entitled "Michipicoten Island to Oiseau Bay" will be published from the information obtained by this survey during 1915-16.

KINGSTON HARBOUR.

Mr. Paul Jobin, and assistants, with the use of a gasolene launch, carried on the re-survey of the entrance to Kingston harbour. He was unable to complete this survey, and it will therefore be necessary to continue it during the summer of 1917.

AUTOMATIC GAUGES.

Mr. Charles Price was entrusted with the work of looking after the automatic gauges on the Great Lakes and St. Lawrence river. Eleven gauges on

the Great Lakes and eighteen on the St. Lawrence river were operated. At Sorel and Pointe Claire the gauges are operated throughout the year. Difficulty was experienced in obtaining reliable men to take readings of the different gauges operated.

The report of the Chief Hydrographer on the work of the Hydrographic Survey for the past year may be found at page 11.

4. CANADIAN ARCTIC EXPEDITION.

The Canadian Arctic Expedition set out for the North in 1913. Owing to the varied nature of the work to be carried out, and the vast area to be covered, it was decided to divide the expedition into two parties; the Northern and the Southern divisions. The Northern division was to explore the hitherto unknown parts of Beaufort sea, and carry on investigations on the northern islands; they were also to search for new land and to definitely locate any found.

NORTHERN DIVISION.

The members of the Northern division set out in C.G.S. *Karluk*. They were to proceed to Banks island or Prince Patrick island, where a base was to be established. Shortly after passing Point Barrow, however, the vessel became ice-bound and was carried eastward far down the northern coast, as far as Thetis island, where the drifting of the ice ceased. As it appeared that the vessel was frozen in for the winter, Mr. Stefansson, accompanied by Mr. B. M. McConnell, George H. Wilkins, and D. Jenness, set out for the mainland on a hunting trip. During their absence, the vessel with the remainder of the Northern division was carried away and drifted until the 11th January, when it was crushed by the ice, and sunk. In endeavouring to reach Herald island, eight members of the party lost their lives. The remainder, numbering nine men, including Capt. R. A. Bartlett, succeeded in reaching Wrangel island. Captain Bartlett journeyed on foot over the ice to the Siberian coast, and thence to Alaska in the *Herman*, where he was able to communicate with the outside world, to have relief ships sent. The shipwrecked men were taken from Wrangel island by the schooners *King* and *Wing*, and transferred to the United States revenue cutter *Bear*, which landed them at Victoria.

When Mr. Stefansson and his companions found that their vessel had been carried away, they journeyed along the northern coast to Collinson point, where the Southern division of the expedition was established. Although Mr. Stefansson was not aware of the *Karluk's* fate, he realized that the vessel would not be available to assist in the work of the Northern division. He therefore made arrangements to journey on foot over the ice to explore unknown parts of Beaufort sea, it being understood that a vessel would be sent to Banks island in the summer of 1914, provided he did not return before the breaking up of the ice. On his trip across Beaufort sea, Mr. Stefansson covered an area which was hitherto very little known. The party was carried eastward by the drift of the ice to near the 140th meridian, which they followed north to 72° 58' 23" north.

During their journey over the ice, soundings were taken at short intervals, particularly in the vicinity of the outer edge of the continental shelf. Owing to the breaking up of the ice, they were compelled to make for land and arrived at Norway island on the 24th June, 1914. They spent the summer on northern Banks island, until September, when they journeyed south to Kellett, where Geo. Wilkins, who had come north with the *Mary Sachs*, was met. A base was established at Kellett from which Mr. Stefansson made a journey to De Salis bay across southern Banks island early in December, to locate Eskimos in the vicinity of Prince of Wales strait. Failing to locate them, he returned to Kellett, where arrangements for a trip northward were completed. Early in February, 1915, the ice party, composed of Vilhjalmur Stefansson, Storker Storkerson, Ole Andreason, and Charles Thomsen, set out northward, following the west coast of Banks island as far as cape Alfred. From cape Alfred they set out across the ice in a northwesterly direction, taking similar observations as they advanced as had been taken on the ice journey over Beaufort sea the previous year. On both these journeys it was ascertained that no land exists for a considerable distance on either side of the area over which they travelled. As the ice in Beaufort sea began to break up on the 28th April, they were obliged to discontinue the ice expedition for the season of 1915, and make for land, They arrived at Lands End, Prince Patrick island, and followed its shore northeast to cape McClintock. A survey of the shore was made during this journey. From cape McClintock they again set out over the ice in a northerly direction. On the 18th June, three days after setting out, land unmarked on any chart was seen. The ice party landed on the shore of the new land, at the southwestern entrance of a bay about twenty miles in width. They crossed the entrance of this bay, and proceeded along the shore for a distance of about twenty miles. From observations taken from neighbouring hills, the land appeared to be extensive, hills appearing blue in the distance having been seen. A considerable number of animals, including seals, caribou, foxes, etc., were found in the vicinity. Owing to the lateness of the season, the party were obliged to hasten back to Kellett, without making any more extensive investigations. The party arrived at Kellett on the 8th August.

Mr. Stefansson went in the *Poler Bear* to Baillie island to despatch and receive mail and to obtain the services of another vessel. After leaving instructions for the *"North Star"* to go to Kellett as soon as possible, he returned to Banks island. On the 3rd September, 1915, the *Polar Bear*, which was purchased for the use of the expedition, set out along the west coast of Banks island. Ice, however, prevented the vessel from going farther than cape Kellett. It was decided, therefore, to endeavour to go north through Prince of Wales strait on the east coast of Banks island. They were able to go only as far as Princess Royal islands, where they were obliged to winter.

In the fall of 1915, a considerable part of the hitherto unmapped shoreline of Victoria island was completed. Several trips, including a journey across southern Banks island to Kellett, were made. On the journey to Kellett much useful and interesting information with reference to the overland route across southern Banks island was obtained. Upon arrival at Kellett, Mr. Stefansson

decided to carry out the next year's journeys from there, and on the 6th January 1916, sent a party to the *Polar Bear* to inform the members at that base of the arrangements made. This party, however, experienced great difficulties in reaching the *Polar Bear*, so that instructions were received too late to be carried out. Under the circumstances, Mr. Storkerson, in charge of the *Polar Bear* base, decided to proceed north to the new land, where he began to carry on survey work. When the *Polar Bear* party failed to arrive within a reasonable time at cape Alfred, which was the place of rendezvous, Mr. Stefansson undertook to locate them, and found out that they had gone to the new land. The Stefansson party left cape Ross for the new land on the 19th April, 1916, and met Mr. Storkerson on the 3rd May at cape James Murray. From this point, the last mail from the expedition received in the department was despatched. The work of the Northern expedition for the season 1916-17 gives promise of producing very favourable results.

The further reports of the different expeditions carried on and also details of the new land discovered, are awaited with great interest.

SOUTHERN DIVISION.

The ice conditions which proved so disastrous to the first efforts of the Northern division, and which caused the destruction of C.G.S. *Karluk*, prevented the members of the Southern division from proceeding farther than Collinson point, Alaska. Their two vessels, the *Alaska* and *Mary Sachs*, were put in winter quarters, and the party established a base there.

During the winter and spring, up to the opening of navigation, the work of the expedition was carried out along the coast of Canada as far as the Mackenzie River delta, their operations being limited to geological and meteorological work, the carrying on of a survey from Demarkation point to Herschel island, an examination of Herschel Island river, and the survey of the west branch of the Mackenzie river delta. Upon the opening of navigation, the party, with the use of the above-named vessels, proceeded along the north coast of Canada eastward, through Amundsen gulf, and Dolphin and Union strait, to a point almost directly south of Sutton and Liston islands. There they entered a small harbour unmarked on the charts, which is well protected and gives good anchorage. They named it Bernard harbour, and established a base for carrying on the work of the Southern division.

During the two years following, up to the 13th July, 1916, the regular work of the division was carried out very successfully, and a survey of the mainland coast in detail from Alaska, Yukon Territory, international boundary, to the Mackenzie river, was completed.

A traverse of the Firth river, Y.T., was made, and the east and west branches of the Mackenzie river delta and the mainland coast from the west side of Darnley bay to a point well down in Bathurst inlet, as well as a large number of islands in Coronation gulf and Bathurst inlet, were surveyed. Hornaday river, Crocker river, Rae river, Tree river, and many others hitherto unexplored, were traversed, and an examination of the territory around the mouth of

Hood river was carried out. An examination was also made of Collinson point harbour, Bernard harbour, Chantry island, and the country immediately surrounding these places. Maps of all the districts named are in preparation.

The geological features of all areas covered have been carefully investigated, and the relations of the different formations have been studied in detail at the most important points of contact. As a result of the geological investigation, detailed particulars and an estimation of the available copper-bearing rocks in a new area hitherto very slightly known in the Bathurst inlet region, have been obtained. In the branches of ethnology and anthropology, extensive collections of specimens were taken from Arctic Alaska, Coronation gulf, Dolphin and Union strait, and Victoria island. Gramophone records of Eskimo folk lore, language, dance songs, and shamanistic performances, with careful transcriptions and translations, were made. A careful study of the languages and vocabularies, manners, social and religious customs, games, amusements, and general culture of the Eskimo was also made.

In the departments of marine, biology, entomology, and botany, careful studies were made at all points visited, and the life-histories of the arctic insects, animals, and plants were investigated. Specimens of the arctic plants, animals and insects were also obtained. In mammalogy and ornithology, fairly complete collections were made in the regions traversed; 619 specimens of birds, including 73 species, were obtained. The collections of mammals numbers 431 specimens, including 22 species.

Meteorological observations with barograph; thermograph; maximum, minimum, and standard thermometers; mercurial barometer, and anomometer were carried out during the three years. Trial observations were taken at Collinson point, Demarkation point, and Bernard harbour.

Upon the completion of their activities, the Southern division sailed from Bernard harbour, on the 13th July, 1916. At Young point, heavy ice was encountered, and the party were held up for four days. They worked their way through the ice on the 21st July, and followed an open lead outside of the ice, pressing along the south side of Amundsen gulf and Dolphin and Union strait. This ice did not extend farther west than the Crocker river, after which the ocean was comparatively free. At Bailley island, several Eskimos attached to the party were discharged, having been paid chiefly in stores. Herschel island was reached on the 28th July, where the surplus stores from the *Alaska* were left in care of the Royal Northwest Mounted Police, for the use of the Northern division should they be required. At Herschel island, also, the services of additional Eskimos were dispensed with. West of this point, heavy ice was encountered, from the international boundary to point Barrow. Nome was reached on the 15th August, 1916. After unloading the specimens, the vessel was hauled up on the beach, and left in charge of the Alaska Lighterage and Commercial Co. The specimens were shipped by the regular steamship route to Ottawa, via Seattle. The members of the expedition left Nome for Seattle on the 27th August.

Upon their arrival at Ottawa, the different members of the Southern division immediately began work upon the preparation of their reports. A very large number of specimens, hitherto unknown, were brought out. It was necessary to have these arranged, grouped, and catalogued. In order to carry out the work, the assistance of eminent specialists, both from Canada and from outside countries, was required. For the purpose of distributing these specimens among specialists who would be likely to give them the best attention, and obtain the fullest information available, a committee of scientists, composed of Dr. R. M. Anderson, of the Expedition; Prof. E. E. Prince, Dominion Commissioner of Fisheries; Prof. A. B. McCallum, Dominion Entomologist; Dr. C. Gordon Hewitt; and Mr. James Macoun, of the Geological Survey, was appointed. This committee has already begun the work of distributing the specimens.

A report of the activities of the northern division of the expedition may be found at page 22.

A detailed report of the activities of the Southern division by Dr. R. M. Anderson, may be found at page 28.

5. RADIOTELEGRAPH BRANCH.

During last year 156 radiotelegraph stations were in operation. Owing to the war, the Coast stations have been maintained on a war basis.

Following is comparative statement of business handled during 1915-16 and 1916-17:—

Service	1915–16.		1916–17		Increase or decrease.	
	Messages.	Words.	Messages.	Words.	Messages.	Words.
East Coast	45,195	846,020	37,835	704,469	7,360	Decrease. 159,551
Great Lakes	13,617	259,366	16,521	311,800	2,904	Increase. 52,434
West Coast	95,648	1,103,395	121,126	1,732,420	26,172	Increase. 629,025
Hudson Bay	7,617	570,281	6,264	392,154	1,353	Decrease. 178,127
Total	161,477	2,797,062	181,740	3,140,843	20,263	Increase. 343,781

The radiotelegraph stations on the east coast and Great Lakes are operated by the Marconi Wireless Telegraph Company, under contract, for the department. The west coast stations are operated directly by the department, and the Hudson Bay stations are operated by the department for the department of Railways and Canals.

The revenue derived from this service shows a very gratifying increase over last year, observing that the war has greatly diminished the business carried on by wireless.

The following statement gives the revenue collected last year as compared with 1915-16:—

Locality.	1915-16.	1916-17.	Increase or decrease.
	$ cts.	$ cts.	$ cts.
East Coast	1,022 33	987 67	Decrease 34 66
Great Lakes	78 16	107 90	Increase 29 74
West Coast	7,394 50	15,635 76	Increase 8,243 26
Total	8,494 99	16,731 33	Net Increase 8,236.34

In addition to carrying on the work of operating the different radiotelegraph stations, the branch also undertakes the examination of wireless operators and the licensing of all radio sets on land and on Canadian ships. Owing to the very secret nature of a considerable part of the work handled by the wireless operators, it was deemed advisable to make them amenable to naval discipline. The rank of wireless operator, R.N.C.V.R., was accordingly established in which all wireless operators in the Canadian Naval Service have been entered.

During the past year 135 operators were examined, including eight re-examinations, of which sixty-four were successful. Eight holders of certificates of proficiency were successful in examinations for the operation of other equipments, and their certificates were amended accordingly.

The policy of the department to bring the radiotelegraph stations under the ownership of the Government was further advanced during the past year by the purchase of the North Sydney station from the Marconi Wireless Company.

The value of an efficient wireless service was further demonstrated by the valuable services rendered to vessels in distress which resulted in the saving of many lives and much property.

In continuance of the department policy of keeping the stations thoroughly up to date, improvements and additions were made at the following stations:—

West Coast: Cape Lazo, Dead Tree Point, Estevan, Gonzales Hill, Pachena, Point Grey, and Triangle Island.

East Coast: North Sydney.

Great Lakes: Point Edward, Port Burwell, Headquarters, Ottawa.

The radio regulations were amended during the past year to prohibit the working of ship stations while in harbour, to limit the ship stations to the use of a 600-meter wave length, and to debar all except British subjects of British parentage from entering the service. The department has also to equip numerous Admiralty transports with radiotelegraph apparatus, and to carry out the inspection of same.

The total personnel of the government radiotelegraph service, including the officers at the headquarters office, is 165.

The report of the General Superintendent of Radiotelegraph is appended at page 71.

6. FISHERIES PROTECTION SERVICE.

The following vessels belonging to the Fisheries Protection Service were in commission during the fiscal year 1916-17; *Canada, Curlew, Constance, Petrel, Gulnare, Vigilant, Galiano, Masaspina,* and *Restless.*

Owing to the urgent need of vessels for patrol service and examination service in connection with the defence of the Canadian coasts, the *Canada, Constance, Gulnare,* and *Restless* were utilized by the Naval Service, and were not available for Fisheries Protection duties at any time during the year. They maintained a close watch for illegal fishing, however, whilst on Naval Patrol Service.

These vessels, as well as the other Fisheries Protection ships, were, however, used to carry out the inspection of the life-saving stations along the east and west coasts and on the Great Lakes, when they were in the vicinity of the stations requiring inspection.

The *Curlew* was utilized, except for short periods, when its services were required for war work, in patrolling the fisheries grounds of the bay of Fundy.

During the season assistance was rendered by the ship to the ss. *Tyne,* ashore near Grand Manan. It also searched unsuccessfully for the barge *Mule* adrift in the bay of Fundy. It towed to safety the ss. *J. L. Cann* from the dangerous position off Briar island. With the aid of the *Curlew* the schooner *W. H. Mason,* which sank in deep water at the entrance of St. Mary's bay, was located, as was also an uncharted rock, off Whitehead island. During the winter, the vessel kept the ice in St. Andrew's harbour broken up, thereby enabling navigation to be carried on.

The *Petrel,* when not on Naval Service, carried out its regular Fisheries Protection duties along the southwest coast of Nova Scotia. The Naval work, however, required the services of the vessel for the greater part of the year.

C.G.S. *Vigilant* was engaged in patrolling the international boundary line in lakes Ontario and Erie throughout the summer of 1916. The ship was laid up at Port Dover on December 23, 1916. During the season the vessel steamed 5,818 miles, and seized 618 nets.

The *Malaspina* was utilized throughout the year, alternately on Fisheries Protection and Naval Service work. Whilst on Fisheries Protection work it was also used to inspect the life-saving and radiotelegraph stations on the west coast. The vessel was also utilized to lay a cable from Leonard island to Vancouver island. Whilst patrolling the ship seized the motor-boat *Greg* for an infraction of the fisheries laws, and handed it over to the Marine Agency at Victoria.

The *Galiano* was on Fisheries Protection duties throughout the year, except for short periods when she was required for examination service. The chief areas patrolled were the fishing grounds in the vicinity of Hecate strait and Barclay sound. This vessel was also used in carrying out the inspection of the radiotelegraph stations on the west coast.

The C.G.S. *Fispa,* a fisheries launch, was placed on fisheries patrol service in the vicinity of Prince Rupert. Although too light for patrolling the open sea,

the *Fispa* did good work in the straits from November to April, when it was returned to the Chief Inspector of Fisheries at New Westminster.

The report of the Director of the Naval Service on the Fisheries Protection Service may be found at page 89.

7. THE LIFE SAVING SERVICE.

The Life-saving Service of Canada has been established for the purpose of saving the lives of those in danger at sea, and for rescuing those on board wrecked vessels along the coasts of Canada. Stations, equipped with life boats manned by trained men, have been built at points along the coasts where navigation is difficult and where wrecks are most prevalent. These stations are not equipped for saving vessels or cargoes but, when practicable, after those on board have been taken off, salving operations are carried out.

This department also undertakes to reward bravery for life-saving at sea, but not along the coasts and in rivers. Cases of the latter should be brought to the attention of the Royal Canadian Humane Association, Hamilton, Ont.

With each succeeding year, as the fishermen equip themselves with modern motor-boats, and the ocean-going ships become larger, the necessity for the life-saving stations at present in operation is becoming less. In most cases fishermen are able to render each other better assistance than the service can provide. For this reason, the question of doing away with some of the least useful stations is being considered.

During the past year the method of inspecting the stations has been revised. The work of inspection was formerly carried out by one inspector. It was considered that the inspections could be equally well done by the officers of the Fisheries Protection vessels patrolling the district. The new system was adopted during the past year, and has proved highly satisfactory.

During the fiscal year 1916-17, thirty-seven stations were in operation, of which twenty-four are located on the east coast, three on the west coast, and ten on the Great Lakes. Five of these stations have permanent crews on duty throughout the year, six have permanent crews on duty during the season of navigation, and the remainder have volunteer crews who drill twice a month and are called out in case of a wreck.

On the east coast, assistance was rendered to disabled vessels or motor-boats by the crews of the stations at Bay View, Canso, Cheticamp, Clark's Harbour, Herring Cove, Seal Island, Brier Island, and Whitehead. The boat at Whitehead was destroyed while going to the assistance of the schooner *J. W. Margerson.* Assistance was also rendered by the crews from Cape Tormentine, Little Wood Island, and Richibucto.

On the Great Lakes the crews from Point Pelee, Port Hope, and Toronto were called out. The Toronto crew's activities were confined to Toronto harbour and they were not called upon to render assistance out in the lake during the year. The Toronto crew, in addition to helping fifty-three different vessels, also gave assistance in cases of drowning, the station being equipped with a pulmotor.

The Bamfield and Ucluelet stations on the west coast also gave assistance to vessels in distress.

The report of the Director of the Naval Service on the Life Saving Service is appended at page 94.

8. STORES BRANCH.

The activities of the Stores Branch of the department are divided into three sections, namely: the Purchasing and Contract, the Storekeeping, and the Transportation.

Purchasing and Contract Section.

This section is responsible for the purchase of all supplies required by Canadian Naval Ships and Establishments, Imperial and Allied vessels calling on Canadian ports, and for supplies required by the other branches of the department. It also attends to the charter of vessels, contracts for construction of new works, buildings, etc., and to the installations required in connection therewith.

During the past year, owing to the increased demand for materials for war purposes, and the difficulty of obtaining same, the work of the branch was rendered much more difficult than previously, but through the energy of the officers and the co-operation of the Canadian manufacturers and dealers, the supplies and equipment were kept up to requirements.

The total liability incurred during the last fiscal year amounts to $7,605,-019. A considerable portion of this amount was expended on behalf of the Imperial and Allied Governments and is recoverable.

Storekeeping Section.

The storekeeping section is responsible for the distribution of supplies to Canadian Ships and Establishments, to Imperial and Allied vessels calling on Canadian ports. This work entails the keeping of a large reserve stock of supplies on hand. This stock is maintained at the Naval bases at Halifax and Esquimalt.

The activities of the Storekeeping section have expanded greatly during the past year, owing to the increase in the number of vessels requiring supplies, the difficulty of obtaining certain materials, and the necessity of substitution in such cases, The reserve stock has, however, been successfully maintained throughout the year.

The total value of receipt of stores at Halifax dockyard for the past year was $805,282, and at Esquimalt $570,496. The issues of stores to Ships and Establishments at Halifax amounted to $592,926, and at Esquimalt $411,270. In addition to the above activities, this branch has also supplied Allied ships and transports sailing from Canada with coal and fuel oil. The total receipts of steaming coal for the year at Halifax dockyard amounted to 78,575 tons, and at Esquimalt 31,711 tons. The issues at Halifax were 77,733 tons, and at Esquimalt 29,626 tons. In addition, the following quantities of Canadian coal were handled on direct issue to ships from contractors: Halifax and the

east coast, 138,509 tons; Esquimalt and the west coast, 16,545 tons. At Halifax, 107,000 gallons of fuel oil were handled, and at Esquimalt 23,943 gallons.

Transportation.

The overseas transport service has, during the past year, very successfully carried out its work of transporting supplies, etc., overseas. The Director of Overseas Transport is responsible for the shipping of overseas supplies; this entails making all arrangements for railway transportation of such supplies, and the loading of same on transports. The Naval Service department is responsible for the procuring of suitable transports, their routing, and keeping the British Admiralty informed as to their movements. The railway companies of Canada have greatly facilitated the work of transportation by their earnest co-operation.

During the past fiscal year, under the direction of the Transport Service, 386 sailings, comprising 2,429,829 tons, cleared from Canadian ports. In the year 1915-16 there were 198 sailings, comprising 970,911 tons. Although the demands on transportation have been very heavy, the service has been able to meet it, and the large quantities of supplies for shipment were handled with practically no delay.

The report of the Director of Stores is appended at page 97.

EXPENDITURES.

The total expenditure of the Naval Service department during the fiscal year 1916–17 was $16,416,839.36. Out of this amount $4,242,489.99 were expended from the regular appropriations and $4,761,991.96 out of the war appropriation; $7,412,357.41 were expended on account of the Imperial and Allied Governments, which amount is recoverable.

General

I have much pleasure in expressing my satisfaction at the efficient manner in which officers of the department have carried out their duties during the year.

I have the honour to be, sir.
Your obedient servant.

G. J. DESBARATS,
Deputy Minister.

OTTAWA July 21st 1917.

The Deputy Minister,
Department of the Naval Service,
Ottawa, Ont.

SIR, I have the honour to submit herewith a financial statement showing the expenditure under the various appropriations, and the revenue received by the Department during the fiscal year ended March 31st, 1917.

The expenditure on account of H.M.C.S. *Niobe*, H.M.C.S. *Rainbow*, the submarines, and other vessels engaged in the defence of our coasts, the Royal Canadian Naval Hospital (Halifax) and extraordinary expenditures for the dockyards at Halifax and Esquimalt have been charged to war appropriation. The ordinary expenditure for the upkeep and maintenance of the Royal Naval College, Halifax and Esquimalt dockyards has been charged to Naval Service appropriation.

A statement of stores supplied, work done and advances made on behalf of the British, French, Italian, Russian Governments, and others, is also submitted. These disbursements amount during the fiscal year 1916–17 to $6,517,816.80, and to this should be added the sum of $718,400.73 transferred from fiscal year 1915–16, thus making a grand total of $7,236,217.53 debited against the Allies, etc., during fiscal year 1916–17. Credits and cash received during the year amount to $7,078,825.70, leaving an outstanding balance of $157,391.83, which is not included in the amounts charged to War or Naval Appropriations, but carried forward in Suspense to the fiscal year 1917–18.

I have the honour to be, sir,
Your obedient servant,

L. J. BEAUSOLEIL
Chief Accountant.

STATEMENT of jobs completed in the workshops and stores supplied by the Halifax and Esquimalt dockyards during fiscal year 1916-17.

Service.	Halifax.	Esquimalt.
	$ cts.	$ cts.
Naval Service	560,621 15	264,284 17
Fisheries Protection Service	28,413 21	32,900 30
Hydrographic Surveys	11,579 65	5,828 42
Life Saving Service	1,670 71	3,257 99
Radiotelegraph Service	3,114 65	2,312 42
Fishery Patrol Service	5,058 02	1,236 33
British Admiralty	247,647 82	404,778 43
French Admiralty	4,171 10	
Italian Government	1,678 48	
Department of Marine		2,423 87
Department of Militia and Defence		404 49
Sundries	1,821 87	9,173 10
	(A)865,776 66	726,599 52
(B) Wages paid	168,100 05	274,897 53
Salaries	32,588 97	40,172 52
(C) Stores issued	683,906 22	416,167 61

(B) and (C) included in (A).

SESSIONAL PAPER No. 33

STATEMENT of appropriation accounts for fiscal year 1916-17.

Service.	Appropriation.	Expenditure.	Balance unexpended.
	$ cts.	$ cts.	$ cts.
Naval Service	1,000,000 00	578,580 57	421,419 43
Fisheries Protection Service	375,000 00	110,317 26	264,682 74
Hydrographic Surveys	290,000 00	223,846 53	66,153 47
Radiotelegraph Service	295,000 00	182,536 39	112,463 61
Tidal Service	35,000 00	19,465 77	15,534 23
Patrol of the Northern Waters of Canada	50,000 00	20,333 75	29,666 25
New Fisheries Protection Steamers	30,000 00		30,000 00
Rewards for Saving Life, including Life Saving Service	125,400 00	99,150 09	26,249 91
	2,200,400 00	1,234,230 36	966,169 64
Fisheries—			
Salaries and Disbursements of Fishery Officers	305,000 00	243,878 02	61,121 98
Building Fishways and Clearing rivers	30,000 00	4,564 78	25,435 22
Legal and Incidental expenses	4,000 00	3,027 16	972 84
Canadian Fisheries Museum	8,000 00	5,248 56	2,751 44
Oyster Culture	6,000 00	5,003 74	996 26
Cold Storage and transportation of fish	125,000 00	80,042 33	44,957 67
Dogfish Reduction Works	60,000 00	31,472 82	28,527 18
Services of Customs Officers *re Modus Vivendi* Licenses	900 00	364 20	535 80
Fisheries Intelligence Bureau	5,000 00	3,877 84	1,122 16
Fisheries Patrol Service	190,000 00	157,412 73	32,587 27
Fisheries Exhibit (Toronto Exhibition)	10,000 00	8,594 09	1,405 91
Fish Breeding establishments	400,000 00	275,166 53	124,833 47
Inspection of Canned and Pickled fish	25,000 00	12,007 96	12,992 04
Building Fisheries Patrol boats	30,000 00	33,495 13	*3,495 13
Compassionate allowances	3,000 00	3,000 00	
Marine Biological stations and investigations	26,000 00	26,000 00	
	1,227,900 00	893,155 89	334,744 11
Civil Government Salaries	180,950 00	155,237 37	25,712 63
Contingencies	50,000 00	46,829 63	3,170 37
	230,950 00	202,067 00	28,883 00
Fishing Bounty	160,000 00	159,999 80	0 20

*Grant exceeded.

RECAPITULATION.

Naval Service	2,200,400 00	1,234,230 36	966,169 64
Fisheries	1,227,900 00	893,155 89	334,744 11
Civil Government	180,950 00	155,237 37	25,712 63
Contingencies	50,000 00	46,829 63	3,170 37
Fishing Bounty	160,000 00	159,999 80	0 20
	3,819,250 00	2,489,453 05	1,329,796 95
	$ cts.	$ cts.	
War Appropriation:—			
Disbursements	10,324,145 99		
Carried from 1915–16	718,400 73		
Gross expenditure		11,042,546 72	
Less:—			
Re-imbursements and Credits	$ 7,078,825 70		
Transferred to 1917–18	157,391 83	7,236,217 53	
Net expenditure			3,806,329 19
Imperial Government (Special Account)			260,000 00
Total expenditure fiscal year 1916–17			6,555,782 24

STATEMENT showing amounts outstanding in respect to stores supplied, work done and advances made, etc., at end of fiscal year 1916-17.

SUSPENSE ACCOUNTS.

	Debits.	Credits.	Balance Transferred to 1917–18.
	$ cts.	$ cts.	$ cts.
British Admiralty	6,510,688 47	6,395,692 01	114,996 46
French Admiralty	84,024 56	64,248 78	19,775 78
Italian Government	2,948 95		2,948 95
Russian Government	6,842 65		6,842 65
Japanese Government	1,447 23	1,447 23	
War Office	26,946 46	26,946 46	
Commonwealth of Australia	70,385 59	70,375 84	9 75
Department of Militia and Defence	402,871 15	402,528 74	342 41
Miscellaneous	130,062 47	117,586 64	12,475 83
	7,236,217 53	7,078,825 70	157,391 83

STATEMENT of revenue of the Department of the Naval Service for fiscal year ended March 31, 1917.

	$ cts.	$ cts.
Royal Naval College—College fees (26 Cadets)		2,600 00
Fisheries Revenue		98,629 67
Modus Vivendi (Licenses to U.S. fishing vessels)		5,680 50
Casual Revenue		26,379 07
Miscellaneous Revenue		760 32
Wireless Apparatus Licenses		214 25
Wireless Operators Examination fees		147 00
Radiotelegraph Revenue:—		
Alert Bay Station	472 10	
Cape Lazo Station	589 56	
Dead Tree Point Station	547 03	
Digby Island Station	2,613 44	
Estevan Point Station	1,635 53	
Gonzales Hill Station	3,398 03	
Ikeda Head Station	355 96	
Pachena Point Station	127 20	
Point Grey Station	2,358 49	
Triangle Island Station	3,538 42	
Malaspina Station	5 96	
Galiano Station	4 17	
Camperdown Station	293 50	
North Sydney Station	223 66	
Sable Island Station	107 67	
Magdalen Islands Station	362 84	
Midland Station	9 60	
Point Edward Station	28 57	
Port Arthur Station	18 05	
Port Burwell Station	8 28	
Sault Ste. Marie Station	27 52	
Tobermory Station	4 56	
Toronto Station	11 32	16,741 46
		151.152 27

Fisheries Revenue for fiscal year ended March 31, 1917.

Province.	Amount Collected.	Refunds.	Net Amount.
	$ cts.	$ cts.	$ cts.
Ontario	808 70		808 70
Quebec	6,981 14		6,981 14
New Brunswick	15,137 19		15,137 19
Nova Scotia	7,178 70	2 00	7,176 70
Prince Edward Island	3,605 18	8 00	3,597 18
Manitoba	8,252 27		8,252 27
Saskatchewan	3,103 25		3,103 25
Alberta	5,993 40	23 00	5,970 40
British Columbia	47,330 84	3 00	47,327 84
Yukon	275 00		275 00
	98,665 67	36 00	98,629 67
Modus Vivendi Licenses	5,680 50		5,680 50
			104,310 17

STATEMENT of expenditure under the war appropriation for fiscal year ended March 31, 1917.

Ship or Establishment.	Pay and Allowances.	Stores and Allowances.	Medical Services.	Subsistence of Prisoners	Recruiting Expenses.	Repairs and Maintenance.	Purchase of Ships and Alterations.	New Ships Building.	Works, Lands, Buildings.	Misc. Effective Services.	Non-Effective Pay and Separation. Allowances.	Charter of Vessels.	Total.
	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.
H.M.C.S. "Niobe"	223,925 42	273,685 06	1,733 44	149 40	367 73	19,965 90				25,954 34	1,687 96		547,463 25
H.M.C.S. "Rainbow"	150,625 87	67,467 70	1,930 37	252 55		37,167 45				5,008 33	2,092 99		264,545 26
Submarines and Depot	91,569 98	56,872 41	2,106 75	85 45		34,663 17				7,505 44	480 76		193,283 96
H.M.C.S. "Shearwater" (Shore Depot)	93,942 20	87,931 30	2,192 70	483 55	6,446 63					5,936 89	479 78		197,413 05
H.M.C.S. "Shearwater" (Ship)						5,352 76							5,352 76
H.M.C.S. "Diana" (Depot)	Credit 8 70	821 25	7 50	28 50						676 66			1,525 21
H.M.C.S. "Canada"	37,634 37	29,775 68	210 42	8 10		13,283 12				1,429 63			82,341 32
H.M.C.S. "Margaret"	40,156 94	36,222 28	234 49			16,187 72				1,530 41			94,331 84
H.M.C.S. "Florence"	9,690 04	9,320 62	153 50			7,730 93				2,548 63			29,443 72
H.M.C.S. "Hochelaga"	34,664 90	32,334 06	159 96			10,214 29				1,211 44			78,584 65
H.M.C.S. "Stradacona"	35,055 04	30,298 85	189 39			11,262 57				1,561 05			78,366 90
H.M.C.S. "Grilse"	25,613 01	18,571 85	179 47			14,520 66				1,335 76			60,220 75
H.M.C.S. "Acadia"	8,801 25	12,478 55				5,541 71				114 28			26,935 79
H.M.C.S. "Tuna"	1,228 15	8,703 41				29,225 55				995 20			40,152 31
H.M.C.S. "Speedy"	6,878 95	5,369 72				2,703 24				370 03			15,121 94
Hopper Barge No. 2	5,364 09	11,331 21				2,402 23				1,141 23			20,238 76
Patrol Vessel No. 1							109,378 03						109,378 03
Patrol Vessel No. 2							109,229 28						109,229 28
Patrol Vessel No. 3							109,547 53						109,547 53
Patrol Vessel No. 4							109,705 06						109,705 06
Patrol Vessel No. 5							109,406 16						109,406 16
6 Steel Trawlers (Polson)								200,234 29					200,234 29
Barrington and N. Sydney W/S									2,775 99				2,775 99
Halifax Dockyard		880 83				22,575 00			1,750 00				25,205 83
Esquimalt Dockyard		593 31											593 31

Atlantic Coast Defence)	118,219 63	105,049 75	268 27			18,873 63					72,692 11		284,502 65	599,606 04
Pacific Coast Defence	36,955 46	31,053 03				14,140 84					5,884 02		3,596 94	91,630 29
R.C.N. Hospital		2 40								10,620 87	13 45			10,636 72
R.N.C.V.R. Overseas Division	102,126 53	110,761 38			79,249 57						58,683 32	17,291 19		368,111 99
Headquarters	49,107 95	49 12	24 69								14,467 23			63,648 99
General Account		57,682 59			8,382 61	5,660 32					161,640 55	159,034 66		392,400 73
	1,071,351 08	987,256 36	9,390 95	1,007 55	94,446 54	271,471 09	547,266 06	200,234 29	15,146 86	370,700 00	181,067 34	288,099 59	4,037,437 71	

Less Credits:—	
H.M.C.S. "Niobe" Guns and gun mountings	175,497 79
H.M.S. "Protesilaus" Refund by B. Admiralty	28,009 69
Hopper Barge No. 2. Water delivered to Sundry Vessels	19,267 72
War Donations (Thos. Robb Esq.)	8,333 32
Net Expenditure	3,806,329 19

STATEMENT of expenditure under the naval appropriation for fiscal year ended March 31, 1917.

	Royal Naval College.	Halifax Dockyard.	Esquimalt Dockyard.	H.M.C.S. "Niobe".	Head Quarters.	General Account.	Total.
	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.
Pay and Allowances	50,031 28		211 10	5,039 19	16,006 06		71,287 63
Stores and Allowances	15,912 94	166,485 89	246,937 58		1,342 98	6,688 45	437,367 84
Medical Services	288 62	18 28	35 00		286 50		628 40
Cadets Misc. Expenses	925 88						925 88
Repairs and Maintenance	5,581 12	66,823 82	83,328 23				155,733 17
Works, Lands, Buildings	10,282 81	1,280 02					11,562 83
Misc. Effective Services	12,694 91	2,184 80	3,208 91		400 65	1,077 24	19,566 51
Non-Effective Pay	498 80			200 00			698 80
Depreciation			4,134 43				4,134 43
	96,216 36	236,792 81	337,855 25	5,239 19	18,036 19	7,765 69	701,905 49
Less credits:—							
Percentage on Stores		18,783 51	39,263 95				58,047 46
Percentage on Labour		8,613 59	50,468 92				59,082 51
Arisings		6,194 95					6,194 95
Net Expenditure	96,216 36	203,200 76	248,122 38	5,239 19	18,036 19	7,765 69	578,580 57

OTTAWA, APRIL 1, 1917.

The Deputy Minister,
Department of the Naval Service,
Ottawa, Canada.

SIR,—I have the honour to report regarding the Naval Service, for the fiscal year ending 31st March, 1917.

The progress, both mental and physical, of the cadets at the Royal Naval College at Halifax still proves most satisfactory. An examination for the entry of cadets to the college was held in May, 1916, and fourteen cadets were entered. The officers of the college continue to report most favourably on the cadets, and the midshipmen who have been serving in ships of the Royal Navy, H.M.C. ships *Niobe*, *Rainbow*, submarines *C.C.1.* and *C.C.2*, and patrol vessels, have also been most favourably reported upon and proved themselves capable and efficient. The fourteen midshipmen who entered the college in January, 1911, have been promoted to acting lieutenant. All these officers are now serving in the Royal Navy.

The requisite number of the personnel for the manning of all H.M.C. Ships and Establishments has been maintained by the entry of men with previous naval experience, and by the employment of R.N.C.V.R. officers and men.

H.M.C.S. *Niobe* continues to be employed as a depot ship at Halifax, and has also been parent ship for vessels employed on patrol work.

H.M.C.S. *Rainbow* has been continuously employed on the west coast in trade protection and other important duties, under the orders of the Imperial Senior Naval Officer of that station.

The two submarines and their parent ship, the *Shearwater*, have been actively employed for the defence of the British Columbian coasts.

A large number of other vessels, both governmental and private, are being utilized in connection with the naval defence of the coasts on such duties as examination service, mine-sweeping, patrols, and other necessary work.

Commodore Sir Charles H. Coke, K.C.V.O., recently arrived in Canada, having been lent by the Imperial Government to take charge of the Atlantic patrol, acting under the orders of this department.

The Naval Volunteers continue to do good work ashore and afloat, a considerable number serving continuously in H.M. and H.M.C. ships and vessels, both on the Atlantic and Pacific coasts of the Dominion.

Captain the Honourable R. Guinness, R.N.V.R., arrived in Canada in May, 1916, for the purpose of recruiting for the Royal Navy; however, it was decided, mainly on account of the comparatively low rates of pay in force in the Royal Navy, that this was not practicable, and the Dominion Government offered to divert to the Naval Service part of the quota which would otherwise be contributed to the Army, and to allow these men Canadian rates of pay, the men being enrolled as Canadian Naval Volunteers and placed at the disposal of the Admiralty.

This offer was accepted by the Imperial Government, and up to date, 1331 men have been enrolled in the R.N.C.V.R. (Overseas Division), of whom 1188 have actually been sent overseas.

The recruiting for this division was carried out entirely by this department, Captain Guinness assisting by holding recruiting meetings throughout the Dominion.

The selection of candidates for the Royal Naval Air Service had continued, and a total of 382 officers has been entered for this service. Those entered since 20th July, 1916, have not been required to obtain their Aero Club certificates before going to England.

Commander F. P. Armstrong, with a recruiting committee, arrived in Canada in April, 1916, for the purpose of entering officers and men for the Auxiliary Patrol (motor-boat) service. The following gives the total numbers entered by him in Canada:—

Sub-lieutenants	264
Chief motor mechanics	52
Motor mechanics	60

Commander Armstrong left Vancouver for New Zealand on the 30th August, 1916.

The duties and work carried out by the Naval Staff Office continue to increase in magnitude and importance, and have been carried out in a very satisfactory manner.

I have the honour to be, sir,
Your obedient servant,

C. E. KINGSMILL, Admiral,
Director of the Naval Service.

SURVEY OF TIDES AND CURRENTS.

Department of the Naval Service,
Ottawa, March 31, 1917.

The Deputy Minister,
Department of the Naval Service,
Ottawa.

Sir,—I have the honour to submit the following report regarding the Survey of Tides and Currents during the twelve months ending March 31, 1917.

One direction in which considerable progress has been made is in the methods of calculation for slack water; the improvements being based upon the experience gained in correlating the current with the tide in a number of different straits and narrows, both in eastern Canada and on the Pacific coast. Some new methods resulting from the investigations made have been applied with success to the calculation of slack water in the passes of the Pacific coast; and this will contribute to the greater accuracy of the tide tables published in future years. The general work of the Survey has been continued without interruption, and further observations of the tides or currents have been carried out during the summer season on both coasts, as well as in Hudson bay.

PRINCIPAL TIDAL STATIONS.

The six principal stations in eastern Canada and five in British Columbia have been maintained in continuous operation throughout the year. The observations obtained from these stations, after careful reduction, are submitted to harmonic analysis, by which tidal constants are obtained as a basis for the calculation of the tide tables. The data for the purpose are thus improved as additional years of tidal record are obtained. As the work of this character was done for the benefit of eastern Canada last year, it was carried forward to improve the tidal constants for the Pacific coast during the present year. Four complete years of tidal record from Clayoquot were submitted to analysis, two years from port Simpson, two years from Prince Rupert, and one year from Vancouver. Also two complete years of tidal record from point Atkinson were reduced; this being a new station for the strait of Georgia, which is found to be practically identical with Sand Heads. The observations at Sand Heads were obtained in the early years of this Survey at the lighthouse there, which has since been removed and replaced by a lightship. These further observations at point Atkinson will enable the observations to be carried forward for a longer period. This work of reduction and analysis will improve, therefore, the accuracy of the tide tables for the ports mentioned, and this will be a distinct advantage as it is from the tide tables at Clayoquot, Sand Heads, and port Simpson, that the various tables of slack water are calculated.

FURTHER TIDAL OBSERVATIONS OBTAINED.

During last season, tidal observations in eastern Canada were obtained at the head of the bay of Fundy and along the north coast of Prince Edward island. On the Pacific coast a tidal station was established at the farthest

available point at the north end of the strait of Georgia and also at points in the channels opposite the north end of Vancouver island, to obtain a basis for the revision of the tidal data in that region, especially in Johnstone strait, where the heaviest traffic takes place.

Bay of Fundy.—The highest tides of the bay of Fundy are known to occur in Cumberland basin, and in Cobequid bay at the eastern end of Minas basin. Fairly extended observations were taken in Cumberland basin during the surveys for the Baie Verte canal in 1870. It appeared, however, from preliminary comparisons of such data as were available, that the tide is higher in Cobequid bay. The upper part of this bay is obstructed with sand bars; and a point was therefore selected at Burntcoat head, which is as far up as the whole tide can be measured at any one locality. There is no wharf at this point, or other artificial facilities, for the erection of a registering tide gauge, so that the observations were taken by direct levelling or by scale readings. The results were compared with simultaneous observations at the principal station for the bay of Fundy, situated at St. John, N.B. The observations in Cumberland basin, which are broken and imperfect, were also carefully reduced for comparison; and some results were also obtained from observations taken for part of a month in 1859 in Noel bay, during the Admiralty surveys for the chart. This bay is within a few miles of Burntcoat head.

The results of this work need not be enlarged upon as they will be given in a special report entitled: "Tides at the head of the bay of Fundy". A full discussion of the behaviour of the tide at this locality at the extreme head of the bay is there given. The data arrived at will throw light upon the features of the tide throughout the bay of Fundy, and will add to our knowledge of tides in general.

Prince Edward island; North Coast.—A series of tide gauges were erected along the north coast of Prince Edward island to obtain simultaneous observations throughout this region. It was desirable to obtain this while the principal station at St. Paul island is still in good working order, as it is one of the most difficult stations to maintain, and the tides of this coast must be referred to it. The points selected for tidal stations were Tignish, Alberton, Malpeque in Richmond bay, Rustico, St. Pierre and Naufrage.

The tide is quite special in its character on this coast, as there are times when only one high water and one low water in the day are pronounced, the other two being effaced. At these times the tide becomes diurnal. There was much difficulty in reducing the observations satisfactorily, but a full explanation of the nature of the tide will be given in the tide tables. The information obtained also enables the characteristics of the tide throughout the southern half of the gulf of St. Lawrence to be more adequately described.

The rise of the tide on this coast is of much value to vessels, especially in heavy weather, as the harbours are largely used for refuge, and most of them have bars across the mouth. A vessel can thus enter more safely at high water during a storm. It is thus always convenient and sometimes necessary for a mariner to know the time of high water.

These observations have also enabled a consistent series of low-water datums to be determined along this coast. This will be of service to the Public Works department for dredging and for harbour improvements.

Lower St. Lawrence.—By co-operation with the Hydrographic Survey, observations were continued at Grand Mechins and Godbout, this latter being practically the same as Point des Monts, the true dividing point between the gulf of St. Lawrence and the estuary. Good results have been obtained from these observations, which will serve as a connecting link between the estuary of the St. Lawrence and the observations obtained in 1910 along the north shore of the gulf from bay of Seven Islands eastward.

Pacific Coast.—In the region of Johnstone strait, through which heavy traffic passes not only from Vancouver to Prince Rupert but also from the Puget Sound ports to Alaska, observations of the tide were obtained in 1900 at Alert bay, Blinkinshop, and Chatham point. These observations were obtained by the survey staff of H.M.S. *Egeria*, and they should properly be referred to Port Simpson; but no observations there in that year were available. A special tide table for comparison was therefore calculated for port Simpson for the year 1900, based on the tidal constants which have been derived from seven years of tidal record there. The comparison enabled tidal differences with port Simpson to be obtained for these three localities. As a further basis for this region, a registering tide gauge was erected at the mouth of Salmon river, twenty-two miles north-west of Chatham point. At this locality, simultaneous observations with the permanent station at port Simpson were obtained during five months. In this way, the tidal data for the whole region from Seymour narrows to Alert bay were carefully revised.

Observations were obtained for the first time at two localities on the back channels off the main line of navigation, namely, at a point in the vicinity of Forward harbour and at Shoal bay at the main angle of Cordero channel, between Bute inlet and Loughborough inlet. The further tidal data thus obtained will be of benefit to the local steamers which have ports of call in this region.

The observations obtained in co-operation with the Hydrographic Survey have afforded improved data for Ocean Falls in Cousins inlet, which has been recently surveyed; and also for Queen Charlotte and Shingle bay in Skidegate inlet, Queen Charlotte islands. A tide gauge supplied to that Survey was erected last season at Granby bay in Observatory inlet, which is rapidly developing as a mining centre. This will enable the time and height of the tide to be known there, with reference to port Simpson.

INVESTIGATION OF THE CURRENTS.

The gut of Canso.—Observations of the turn of the current in this strait were continued during the past season, from May to November. They were taken by the captain of the Ferry steamer *Scotia* assisted by his first officer. After the experience of the previous season, it was possible to get more satisfactory observations and to make them more continuous during the night. Owing to the complex nature of the current, it was found best to plot these observations in the form of a diagram; and from this, a very thorough digest was made, in view of the different variations which the current presents.

The general characteristics and the varying behaviour of this current were found to be in accord with the explanations already given in the tide tables. The longer series of observations enabled more definite values to be obtained for the different elements which go to make up the behaviour which the current actually shows. There is a large inequality in the flow of the current in the two directions which follows the declination of the moon, and this is further complicated by a dominant flow in one direction. It is thus only when the moon is near the equator that it is possible to obtain any satisfactory correlation with the time of the tide. An investigation of this relation was undertaken, however, as it is valuable in showing the best methods by which such problems can be treated. As a final result, it was found that the turn of the currents accords with the time of half tide rising and falling at St. Paul island. This relation with half tide, that is, with the moment midway between the time of high water and low water, or between low water and high water, is an instructive result, as it indicates a principle which may be applicable elsewhere. It is also instructive to know that the current in this strait is related to the tide at St. Paul island which is exactly opposite the gut at the other end of Cape Breton island. It has been found elsewhere that the turn of the current in a strait behind an island is in accord

with the tide on the outside of the island. Such relations indicate the manner in which currents in other regions may be dealt with, in order to calculate the time of slack water for the benefit of the mariner. In this case, the most practical result of the investigation is an explanation of the behaviour of the current so that the navigator may know what to expect.

Seymour Narrows.—From the experience gained in the cases above described, and the successful result which was obtained for Seymour inlet as explained in last year's report, an endeavour was made on similar lines to obtain a better basis for the calculation of slack water in Seymour narrows. After an extended series of trials, a remarkably constant relation was obtained between the time of slack water and half tide; the moment of half tide being half way between high water at Sand Heads in the strait of Georgia and low water at port Simpson. This method applies to the calculation of low-water slack, for which a complex method has been used in calculating the slack water tables during the last three years. It is a declination method, and is described in outline in the tide tables, and although quite satisfactory in itself, it involves an elaborate technique which has to be followed with great care to avoid accidental errors, which would be large if they occurred. The new method of calculation from the time of half tide as above mentioned is simpler, in being straightforward. The reason for the accuracy of the result which it gives is that the variation due to the change in the moon's declination is balanced out by the relative changes in the tides themselves instead of being based on the moon's change in position. By disposing of this variation, which is the most troublesome one to deal with, it becomes possible to apply a correction to take up the variation from springs to neaps. This correction can be applied to both high-water and low-water slack.

These two methods were thoroughly tested out by calculating slack water for three months in the year 1913 and comparing the results with the time of slack water as actually observed. The ultimate advantage obtained may be summed up by saying that this method is quite as accurate as the former declination method and that it eliminates the chance of errors in the calculation. This explanation may also serve to show the advantage that may result from the investigation of the behaviour of all classes of currents in different regions, in the improvement of methods of calculation.

Active Pass.—This pass is the most important of those which lead between the Gulf islands, as it is the one chiefly used by ocean-going vessels between Vancouver and Victoria. The behaviour of the current is more subject to variation than in the other passes, because of its being near to the south end of the chain of Gulf islands. Further observations of slack water in this pass were begun last May and will be continued throughout the winter. Some improvements have already been obtained, in the calculation values for slack water in the tide tables.

It has now been ascertained that a marked improvement in the calculations can be gained by referring high-water slack in this pass to the tide of the open Pacific at Clayoquot and low-water slack to the tide in the strait of Georgia. It has also been found advisable in the case of low-water slack to distinguish the half tide from lower low water; and although this involves considerably more labour in the calculation, it gives a distinctly better result. In the case of high-water slack, the only change allowed for is the annual variation in the values during the successive months of the year. When the present observations are completed, the calculation values will be revised, however, to make them as accurate as possible, and thus to improve the slack water tables.

Similar methods for Porlier pass have been used for the first time in the calculation for the tide tables of 1918. These two passes serve as standard ones from which the time of slack water in the other passes between the Gulf

islands can be obtained by a difference of time. This system of referring one pass to another gives better results than if the time of slack water were obtained with reference to the time of the tide. It is also quite as convenient to the navigator to apply the differences to a table of slack water as to a tide table.

Wellbore channel.—This channel forms an entrance to the eastern passages leading to the Yuculta, which are preferred in the lumber traffic as the most convenient route. Observations of the time of slack water in Whirlpool rapids in Wellbore channel were therefore undertaken during last season from June to November. It was found that the time of slack water in this rapid can be referred to Seymour narrows, in the same way as several other tidal rapids in that region. This information will be of much value to the lumber industry which is developing in that region, as it is only possible, in towing rafts, to pass during slack water.

Hudson Bay and the Arctic Ocean.

Further observations were obtained at Nelson during last season. These were supervised by the wireless operator. The results have enabled the calculations for that port to be improved, and the small changes which the observations show to be necessary, indicate that the present basis of calculation is closely accurate.

Tidal data for James bay have now been obtained for two islands near the head of the bay, and for Moose factory. These two islands have been used as bases for the work of the Hydrographic Survey; and the tidal information was obtained by co-operation with that survey, in supplying it with the necessary outfit. Good data for the tide will thus be available for any railway terminals, or other works which may be contemplated in James bay.

During the progress of the Stefansson expedition, praiseworthy endeavours were made to obtain tidal information at several points in the Arctic ocean. In the vicinity of cape Kellett, simultaneous observations were obtained for a few days at a time at the cape and at a point twenty miles north. Also along the north coast of the main land, tidal observations were obtained at Collinson point, Martin point, and Demarkation point, as well as at Bernard harbour in Union strait.

The difficulty in dealing with these observations is that the tide in these open regions is usually less than one foot in range, and seldom as much as $1\frac{1}{2}$ feet, except in Union strait, where it occasionally exceeds 2 feet. Although the observations were perseveringly taken every 15 minutes day and night for several days at a time, the results that can be obtained from them are rather indefinite. The time of high and low water is necessarily uncertain. Careful abstracts and reductions have been made, however, in the endeavour to determine the establishment at these points, and the range at spring and neap tides. A knowledge of the establishment would be valuable if trustworthy in the circumstances, as it would show the direction in which the tide progresses in the open waters of the Arctic ocean.

INFORMATION SUPPLIED.

As this Survey becomes more widely known, a large number of requests are received for information. Some of these can be met by sending reports or other published information; but in reply to a number of requests it is necessary to work out special data. The new information obtained by this Survey is also communicated to the Hydrographer to the British Navy, to afford improvements in the data for Canada which are published in the British tide tables. Advance information is often communicated also to owners of vessels and

fishing establishments in the regions where further information has been obtained during the season. This reaches them before it can be issued in the tide tables.

The determinations of mean sea-level, made by this Survey at several of the principal tidal stations, have been communicated to the Deputy Head of the Commission of Conservation for his new edition of "Altitudes in Canada." An abstract of the results of these determinations is given, in the introduction to this work, for Halifax, St. John, N.B., Quebec, Victoria, Vancouver and Prince Rupert. This indicated the bases of the altitudes, as they are all referred to mean-sea-level.

The extended levels of the Geodetic Branch of the Public Works Department are run on lines which make frequent connection with the shore between Halifax and Quebec. The benchmarks of the Tidal Survey, as well as some Admiralty bench-marks are thus connected with this system of levels. The Tidal Survey has accordingly supplied the tide levels for a number of localities in this region, which enhances the value of the forthcoming publication of these geodetic levels, as well as affording the corresponding advantage of connecting together the bench-marks of the Tidal Survey which originally were isolated and unconnected.

A similar service has been rendered in connection with the precise levelling of the Dominion observatory; in affording correct determinations of mean sea-level at Halifax, Yarmouth and Vancouver, on the two coasts, as a correct basis for extended levels. The true value of mean sea-level, as determined from continuous observations of the tide during a number of years, is thus proving of value in these levelling operations.

Special information on tide levels and extreme tides has also been deduced during the year from the tidal records now available, to meet the immediate requirements of railway engineers and district engineers of the Public Works Department, in regions in which they are interested.

Accuracy of the Tide Tables.—To test the degree of accuracy that the tide tables have now attained, comparisons have been made between the tables and the tides as actually observed during 1916. This series of comparisons comprised three of the harbours and reference stations in eastern Canada, and five on the Pacific coast. The deduction from these comparisons showed: (1) the average amount of error during the month, and of improvement on former years obtained by the further analysis of tidal record; and (2) any tendency in the tides as calculated for the tide tables, to be early or late on the average. Valuable indications are thus obtained regarding progress made.

PUBLICATION.

Eastern coasts of Canada.—The tide tables for this coast are issued in three editions. One is a complete edition containing all tidal information, and now amounting to 8,000 copies. The other two are abridged editions of pocket size, one for Quebec and the St. Lawrence and the other for St. John and the bay of Fundy. These two editions have now been increased to 21,000, as there are many navigators as well as fishermen who require local information and do not need the complete edition.

Tidal information for Quebec and the St. Lawrence is supplied to the Marine Department for its publication for the ship channel between Montreal and Father Point. This is especially intended for the pilot service. Tidal information for the summer season is also sent locally to three of the summer resorts on the lower St. Lawrence for the convenience of those who frequent these.

Pacific coast.—The circulation of the tide tables on this coast continues to increase. The complete edition for the coast is now 15,000 copies; and an abridged edition for the southern part of British Columbia has been increased to 12,000. This abridgement supplies a large demand for local tide tables for Vancouver, the Fraser river, and the passes in that vicinity. This is found very convenient and serviceable by all classes from pilots to fishermen and for motor-boat traffic.

The tide tables on the Pacific coast are appreciated by the lumber industry and the coal trade, in addition to their direct service to ordinary navigation. The tables are also much used by fishermen, as the best catch is often taken during some special stage of the tide.

The various editions of the tide tables are supplied without charge to the steamship companies, and to all applicants for them. They are largely circulated through the agencies of the Marine Department, the custom offices, pilot and shipping offices. A large proportion of them are mailed individually, and many are sent in reply to requests received.

Republication in Great Britain.—In the general tide tables issued by the British Admiralty there are tide tables for eight important harbours in eastern Canada and the Pacific coast. These are St. John, Halifax, Father Point, and Quebec; and on the Pacific coast Victoria, Sand Heads, Clayoquot and port Simpson. With these tables, tidal differences are given which extend their use to numerous other ports.

Hudson Bay.—Tide tables for Nelson in Hudson bay are published for the months of July to October. The method by which these are calculated has been explained above. The height of the tide is referred to the chart datum. In these tables tidal data are given for Churchill as well as several points in James bay, which have been recently added from new observations obtained there. These tables also include data for six points in the length of Hudson strait, and Ungava bay. The chief matter which is of practical importance there, is the time of the tide, to afford a basis for comparison with the strong tidal streams in this strait. These streams are due to the great rise of the tide, which is from 20 to 35 feet.

Bay of Fundy.—Under the heading of publications may be mentioned the report on " The tides at the head of the bay of Fundy," as already explained herein. This report, now in press, consists of twenty-one pages of text with twelve pages of tables, and two plates comprising a map and a plan. This report will cover information for which requests are often received.

STAFF.

The staff of this Survey for the office and field work, comprises only four in addition to the superintendent, together with the outside tidal observers who number six in eastern Canada and five on the Pacific coast at the permanent tidal stations. In addition to these, several others are employed locally in the summer season, in the observation of tides or currents; and considerable information is also obtained through co-operation with other Surveys, as already explained.

In the field last season, Mr. S. C. Hayden supervised the observation of the currents in the passes of British Columbia, the erection of tide gauges, fitting out the observers, and also inspecting the tidal stations on that coast. In Eastern Canada, Mr. H. W. Jones supervised the erection of the series of summer stations on the north coast of Prince Edward island; and carried out the important repairs to the tide gauge at St. Paul island, in reconstructing the crib work which protects it, and strengthening it with concrete. He also inspected those of the

principal stations which required it. On the bay of Fundy, Mr. R. B. Lee assisted the superintendent in the observations and levelling which form the basis for the special report above mentioned.

During the winter season, the tidal record from the principal stations which accumulates in summer requires attention; and the reduction of this record and its preparation for analysis has to be made. The observations at the summer stations have also to be dealt with, and the slack water observations in the passes and narrows require to be brought to practical shape for calculation purposes, or to afford improved data for mariners. There is also the calculation and publication of five sets of tide tables to be carried out during the winter months. This is done by the same staff as above mentioned, with the assistance of Miss S. L. Howell in the reduction and computations, as well as carrying on the correspondence and attending to the office work in the summer season when most of the staff are away.

I have the honour to be, sir,
Your obedient servant,

W. BELL DAWSON,
Superintendent of Tidal Surveys.

HYDROGRAPHIC SURVEY.

DEPARTMENT OF THE NAVAL SERVICE,
April 1, 1917.

The Deputy Minister,
Department of Naval Service.
Ottawa.

SIR,—I have the honour to submit my report on the work of the Hydrographic Survey during the fiscal year 1916-17. During the year no additions were made to the equipments of the surveys, but all the vessels have been kept in the usual good condition. The following members of the staff have obtained leave and joined the Overseas Forces, namely, Messrs. J. A. Turner; O. R. Parker, R.N.R.; F. Delaute; C. B. R. MacDonald; Norman Wilson; Clifford Smith and W. J. Miller. Commander John Knight, R.N., of the pacific Coast Survey has accepted a commission on the Canadian cruiser *Rainbow*, and Mr. H. H. Lawson has accepted an appointment as instructor in the Royal Military College, Kingston. The positions held by these officers have not been filled.

The following parties were in the field during the summer of 1916:—

First.—The Atlantic Coast Survey, under Captain Anderson, with the steamer *Acadia*, working off the approach to Halifax harbour.

Second.—The Pacific Coast Survey under Lieutenant-Commander P. C. Musgrave, R.N., with the steamer *Lillooet*, working around the Queen Charlotte islands, British Columbia.

Third.—The Lower St. Lawrence Survey under Mr. Charles Savary, with the steamer *Cartier*, working in the mouth of the St. Lawrence river.

Fourth.—The Lake Superior Survey No. 1 under Mr. H. D. Parizeau, with the steamer *La Canadienne*, in Nipigon bay, lake Superior;

Fifth.—The Lake Superior Survey No. 2 under Mr. G. A. Bachand, with the steamer *Bayfield*, working around Michipicoten island, lake Superior;

Sixth.—The Kingston Harbour Survey under Mr. Paul Jobin, with a launch and shore party working at the entrance to Kingston harbour;

Seventh.—The automatic gauges under Mr. Charles Price, superintending the working of the automatic gauges on the Great Lakes and in the St. Lawrence river.

ATLANTIC COAST SURVEY.

The *Acadia* was again fitted out for service at H.M.C. Dockyard, Halifax, and commissioned on the 15th of June.

The work of this party consisted in re-sounding the approach to Halifax harbour, using the Admiralty charts for bases, or the area off that portion of the coast between Egg island and Pennant point. The soundings were carried off shore a distance of 20 miles, and as close inshore as was safe for the navigation of the ship. All the main shoals shown on the Admiralty charts were re-examined, and upon many of them was found considerably less water, whilst in other cases no trace of some of the shoals marked could be found. About two dozen uncharted rocks were located, and Notices to Mariners issued.

The main triangulation of 1916 was extended to the northeastward as far as Liscomb harbour, and to the southwestward as far as port Medway, an extreme distance of 115 miles. Bases about a mile long were measured at each of these harbours, and the agreement with the triangulated lengths was very close.

In the spring a re-survey of Bedford basin was started, and completed during the summer. A new chart on a good scale of this important basin will shortly be issued.

During the season an examination was made of Lockport harbour, and additional shoals found in the entrance to it.

As opportunity offered, observations for magnetic declination were obtained with a Unifilar magnetometer at the following points:—

Station.	Locality.	Latitude.	Longitude	Date.	Declination.
Sand point	Shelburne harbour	N. 43–42..	W. 65–19..	October	19–40·0 West.
Krout point	LaHave river	" 44–17..	" 64–20..	"	21–00·0 "
Hubbards cove	St. Margarets bay	" 44–38..	" 64–03..	September	21–52·8 "
West entrance	Jeddore harbour	" 44–43..	" 63–01..	"	22–37·9 "
MacNab island	Halifax harbour	" 44–37..	" 63–32..	August	22–10·6 "
Near Back Lt. H	Sambro harbour	" 44–28..	" 63–36..	"	21–53·4 "
Day cove	Ship harbour	" 44–45..	" 62–49..	September	22–38·2 "
Monahan I	Sheet harbour	" 44–51..	" 62–32..	November	23–05·0 "
Pye point	Liscomb harbour	" 45–01..	" 62–01..	"	23–30·0 "

Captain Anderson reports that the weather for surveying was exceptionally bad; while not very stormy, very much fog prevailed. Owing to fog and snow and rain, during fifty-four days out of the season of five months, nothing could be accomplished.

The season was brought to a close and the steamer laid up at H.M.C. Dockyard, Halifax, on the 24th of November. On the following day the crew were paid off and the staff returned to Ottawa. The staff for the season consisted of Assistants R. J. Fraser, L. C. Prittie, and J. L. Foreman.

As a result of the season's work the following new charts will be issued:—

" Bedford basin," including the Narrows, on a scale of six inches to one nautical mile;

" Egg island to Pennant point " including Halifax harbour on a scale of eight thousand feet to the inch. For this chart recourse has been taken to the Admiralty charts of the neighbourhood for topography and inshore soundings.

PACIFIC COAST SURVEY.

The steamer *Lillooet* was fitted out at H.M.C. Dockyard, Esquimalt, B.C., and commissioned for service on the 10th of April.

On the passage north, examination was made of Retreat cove in Trincomali channel, and also of Millbank sound, where some additional traversing of the shore-line was carried out and a hunt made for the position of the rock marked " P.D." on the Admiralty chart. The hunt was unsuccessful, so that if the rock does exist, its position has not been determined.

Additional surveying of Alice arm was commenced on the 26th of April, it being the extension of the work done on the chart " Granby bay and approaches." The survey was continued until the 27th of May, and the ship resumed her regular work at Queen Charlotte islands early in June. During the month, sounding was carried off the west side of Queen Charlotte islands in the western approach to Dixon entrance. For the balance of the fine weather, or until the middle of September, work proceeded in Hecate strait and in the neighbourhood of Queen Charlotte city.

On the latter date the party returned to Alice arm, resumed operations and completed the survey of the inlet by the 28th of October. Esquimalt was reached on the 4th of November, where the steamer was laid up and the crew paid off.

In connection with this report, Captain Musgrave expresses his gratitude to the Geodetic Survey of Canada for the great assistance they have given him in connecting his stations with those of its main triangulation and thus giving accurate astronomical positions as groundwork for the Hydrographic Survey charts. In this way, good determinations have been obtained of Prince Rupert, of Granby bay and Alice arm.

A careful examination was made of the east and west narrows of Skidegate channel which gives easy access for fishing vessels operating from Prince Rupert to the fishing grounds west of Queen Charlotte islands. Were some dredging done in these narrows the channel would be much improved.

Owing to Commander Knight and Messrs. Turner and Parker going on active service, the staff of this party was reduced to one assistant, Mr. Davies, so that the usual amount of work was not obtained. It was also necessary to leave the schooner *Naden* out of commission at New Westminster.

LOWER ST. LAWRENCE.

The steamer *Cartier* was fitted out at the Marine Department Agency at Quebec and went into commission on the 8th of May, in charge of Mr. Charles Savary, and Assistants Messrs. Edward Ghysens, M. A. MacKinnon, and E. B. MacColl.

During the season the main triangulation of the south shore was extended as far east as Marten river, and on the north shore to Egg island lighthouse.

As a result of the season's work the survey reached as far east as pointe Des Monts and a new chart entitled " Pointe Des Monts to Father Point " taking in both shores of the St. Lawrence river is about ready for the printer.

The party returned to Quebec about the first week in November and the crew were paid off.

LAKE SUPERIOR PARTY NO. 1.

The steamer *La Canadienne* was fitted out at Owen Sound, and with Mr. H. D. Parizeau and his assistants, Messrs. F. R. Mortimer and H. L. Leadman, left that port on the 4th of May and proceeded to lake Superior, where the survey of Nipigon bay was started on the 12th of May and continued until the 13th of September. On the latter date the party moved to Black bay, but, unfortunately in entering ran aground and by the time the steamer was docked and repaired in the dry-dock at Port Arthur, it was too late to resume operations, which were transferred to Port Arthur and Fort William and continued until the 21st of October, when the steamer left for Owen Sound, arriving on the 5th of November, when the crew were paid off.

On the way east, several shoals that had been reported as omitted from the charts were examined and their positions determined, so that they can be charted. As a result of the season's work an excellent chart of Nipigon bay is now ready for the printer, and will be issued before the opening of navigation 1918.

LAKE SUPERIOR PARTY NO. 2.

The steamer *Bayfield* was fitted out at the Marine Department depot, Prescott, and commissioned on the 1st of May, 1916. Mr. G. A. Bachand, with his assistants, Messrs. J. U. Beauchemin and W. K. Willis, proceeded to lake Superior to take up the work where it was dropped by Mr. Parizeau in the autumn of 1915. Work around Otter head and along the shore to the eastward of it was undertaken in connection with the survey of the shores of Michipicoten island, and continued until the 25th of October, when, owing to bad weather and trouble with the boiler of the steamer, it was deemed advisable to discontinue and proceed to Owen Sound, where the party arrived on the 27th of October.

As a result of the season's work, coupled with some of Mr. Parizeau's work in 1915, a new chart entitled "Michipicoten island to Oiseau bay" has been handed to the King's Printer, and in addition to this, an excellent plan has been made of Quebec harbour, Michipicoten island. I regret to say that both Mr. Parizeau and Mr. Bachand report that work was greatly hindered during the season by lack of crew. The men were very hard to get, wages were high, and they were difficult to handle. I am afraid that due to the unsettled condition of the country, we will have great difficulty in making good headway.

KINGSTON HARBOUR.

Mr. Paul Jobin was supplied with a gasolene launch and instructed to undertake the re-survey of the entrance to Kingston harbour. He arrived at Kingston on the 18th of May, and was joined by an assistant, Mr. LeRoy T. Bowes.

He also had difficulties obtaining men, but eventually settled down to very good work, but was unable to complete the work outlined for him. This work will be continued in the coming season, and a chart issued in the spring of 1918.

AUTOMATIC GAUGES.

The work of looking after the automatic gauges on the Great Lakes and St. Lawrence river as far east as Cap Rouge in is charge of Mr. Charles Price who has been assisted by Mr. C. F. Hannington, C.E., and Mr. A. R. Lee.

The following eleven gauges were operated during 1916 on the Great Lakes:

Port Arthur	Lake Superior	Jan.	1	to Dec.	31.
Michipicoten harbour	"	June	15	"	31
Sault Ste. Marie	Above locks	Jan.	1	"	31.
Sault Ste. Marie	Below locks	Jan.	1	"	31.
Collingwood	Georgian bay	Jan.	1	"	31.
Goderich	Lake Huron	June	1	"	16.
Ile Aux Peches	Detroit river	Jan.	1	"	31.
Fighting island	"	Jan.	1	"	31.
Port Colburne	Lake Erie	Jan.	1	"	31.
Port Dalhousie	Lake Ontario	May	29	"	15.
Kingston	"	Jan.	1	"	31.

During 1916 the following eighteen gauges were operated on the lower St. Lawrence river:—

Pointe Claire	Lake St. Louis	Jan.	1	to Dec.	31.
Verdun	St. Lawrence river	"	1	"	31.
Montreal (foot of lock 1)	" "	April	28	"	23.
Laurier pier, Montreal (new)	" "	July	24	"	22.
Longue pointe	" "	May	1	"	22.
Varennes	" "	April	28	to Nov.	27.
Verchères	" "	"	27	to Dec.	22.
Lanoraie	" "	May	1	to Nov.	25.
Sorel	" "	April	19	to Dec.	31.
Range Light No. 2	Lake St. Peter	May	10	to Nov.	19.
Nicolet river (new)	" "	Aug.	28	"	23.
Three Rivers	St. Lawrence river	April	20	"	27.
Batiscan	" "	May	3	"	25.
Cap à la Roche	" "	"	5	"	24.
Richelieu Rapids	" "	"	20	"	25.
Pointe Platon	" "	"	5	"	14.
Neuville	" "	"	6	"	16.
St. Nicholas	" "	"	8	"	25.

The gauges at Sorel and Pointe Claire are now being maintained during the whole year, and the gauges at Montreal (foot of Lock No. 1) Laurier pier, Longue Pointe, and Verchères, were operated until December 22, 1916, when a sudden raise of water made it necessary to remove them before being flooded. During the past winter there were also two staff gauge readings taken each day at Verdun and Laurier pier.

The seven gauges from Three Rivers to St. Nicholas, inclusive, are compiled by half hourly readings, and the time and elevation of high and low is also tab-

ulated. The work connected with tabulating the records from each of these automatic gauges equals that required by fully four of the regular gauges compiled by hourly readings only.

All gauges are installed and operated from wharves, except at the Nicolet river and the Richelieu rapids. For these two gauges it was necessary to drive piles and erect a platform to work from.

The main difficulty in operating the gauges is in obtaining reliable men as attendants. The lack of care by an attendant often causes the loss of readings and sometimes the breaking down of the gauge itself.

ISSUE OF CHARTS.

During the past year the following new charts were issued from this office:—

106 "Peninsula harbour and port Munro."
68 "Kingston to Deseronto" (bay of Quinte).
69 "Deseronto to Presqu'ile (bay of Quinte).
95 "Meldrum point to St. Joseph island."
310 "Fisher channel and Cousins inlet."
311 "Harbours in Queen Charlotte islands."
84 "Parry Sound and approaches."
85 "McCoy islands to Collins inlet."
89 "Penetanguishene harbour."
312 "Granby bay and approaches."
407 "Anchorages in Hudson strait."
62 "Newcastle harbour to Toronto."
104 "Oiseau bay to Copper island."
210 "Bersimis river to Bic island."
209 "Saguenay river, St. Fulgence to Shipshaw."

The following new editions of former issues of charts have been published:—

207 "Malbaie to Goose island."
50 "Lake St. Louis."
52 "Lake St. Francis" (eastern portion).
53 "Lake St. Francis" (western portion).
94 "Little Current."
204 "Bic island to White island."
86 "Georgian bay to Clapperton island."
7 "Ile Aux Foins to ile de Grace."
8 "Head of lake St. Peter."
16 "Ste. Emmelie to Deschambault."
19 "St. Antoine to St. Augustin."
21 "Quebec harbour."

The Survey is engaged in the preparation of sets of thirty charts each, of the edition published by the late International Waterways Commission, showing the boundary between St. Regis, Quebec, and Pigeon bay. Owing to various difficulties this work has not made as good headway as it should have done, but it is hoped that it will be completed during the summer. The following of the charts were published during the year:—

1 "St. Lawrence river, St. Regis to Dickinson landing."
20 "General chart of lake Huron."
22 "North channel and St. Marys river, Potagannissing bay to foot of Mud lake."
28 "General chart of lake Superior,—Whitefish point to Pigeon bay."

The following works have been issued to the public:—

"St. Lawrence Pilot,—Below Quebec" (new edition);
"Report of the International Waterways Commission" describing the boundary line between St. Regis, Quebec, and Pigeon bay.

In closing this report I have to express my thanks to all the members of the staff for the valuable service they have rendered during the past year.

I have the honour to be, sir,
Your obedient servant,

WM. J. STEWART,
Hydrographer.

MONTHLY MEAN water surface elevations of "Great lakes" for 1916, by automatic water gauges, and referred to mean sea level.

	Location.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
		Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.
Lake Superior	Port Arthur	602·48	602·42	602·22	602·33	603·01	603·50	603·78	603·75	603·83	603·60	603·40	603·09	603·12
St. Mary's river	Above Locks	601·85	601·74	601·43	601·70	602·33	602·75	603·00	603·02	603·02	602·73	602·61	602·27	602·37
	Below Locks	581·83	582·06	582·09	581·90	582·02	582·74	582·89	583·17	583·32	583·35	583·08	582·97	582·62
Georgian bay	Collingwood	579·37	579·51	579·33	579·84	580·43	580·81	581·09	581·07	580·92	580·67	580·70	580·60	580·36
Lake Huron	Goderich	.....	.....	.....	.....	.....	580·91	581·16	581·12	580·94	580·73	580·76	580·74 till 16	580·91
Detroit river	Isle aux Peches	574·37	574·06	573·66	574·57	575·12	575·63	575·67	575·42	574·99	574·68	574·46	574·86	574·79
	Fighting island	573·68	573·65	573·45	574·04	574·51	575·01	575·07	574·80	574·36	574·02	573·76	574·14	574·21
Lake Erie	Port Colborne	571·89	571·93	571·53	572·18	572·62	573·00	573·02	572·58	572·20	571·84	571·70	571·71	572·18
Lake Ontario	Port Dalhousie	.....	.....	.....	.....	.....	247·89	247·92	247·29	246·57	245·95	245·62	245·38 till 15	246·66
	Kingston	244·99	245·22	245·21	245·83	247·07	247·78	247·83	247·25	246·60	246·00	245·60	245·30	246·22

DAILY MEAN water surface elevations of lake St. Louis, at Pointe Claire, Que. for 1916, elevations are above mean sea-level and are referred to C.B.M. CCCCIII on S.E. corner of R.C. Church. Elevation 83.95.

Day.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	68·23	69·45	68·81	70·28	71·98	72·04	70·67	69·36	68·63	68·17	68·34	68·12
2	68·39	69·14*	69·11	70·80	72·07	71·94	70·62	69·24	68·57	68·14	68·34	68·09
3	68·60	69·20	68·95	71·26	72·10*	71·84	70·59	69·17	68·49	68·12	68·34	68·09
4	68·60	69·00	68·71	71·27	72·21*	71·85	70·56	69·17	68·49	68·09	68·30	68·02
5	68·80	68·92	68·46	71·09	72·24	71·86	70·47	69·15	68·49	68·07	68·10	67·98
6	68·80	68·94	68·42	70·99	72·30	71·82	70·40	69·12	68·42	68·05	68·05	68·15
7	69·21	68·88	68·21	71·06	72·33	71·66	70·34	69·10	68·39	68·04	68·06	68·32
8	69·49	68·86	68·12	70·93	72·36	71·48	70·27	69·06	68·39	68·03	68·07	68·37
9	69·49	68·97	68·02	70·75	72·36	71·41	70·16	69·12	68·40	67·98	68·14	68·19
10	69·60	69·03	67·89	70·71	72·32	71·48	70·07	69·26	68·37	67·97*	68·22	68·29
11	69·46	69·24	67·88	70·85	72·30	71·45	70·00	69·25	68·33	.....	68·22	68·41
12	69·20	69·40	68·05	71·09	72·31	71·44	69·97	69·14	68·35	67·89	68·19	68·38
13	69·25	69·10	67·93	71·15*	72·20	71·37	70·01	69·06	68·06	68·89*	68·02*	68·28
14	69·30	68·93	67·77	71·23a	72·06	71·26	69·97	69·04	68·38	67·91*	67·87	68·22
15	69·33	68·96	67·79	71·19a	71·87	71·20	69·82	69·02	68·36	67·93	67·85	68·21
16	69·26	68·96	67·86	71·16a	71·69	71·14	69·78	69·00	68·36	67·95	67·86	68·22
17	69·10	68·85	67·87	71·37a	71·78	71·33	68·87	68·94	68·34	67·99	67·92	68·26
18	69·01	68·56	67·97	71·49a	72·42	71·61	69·86	68·90	68·33	68·05	67·97	68·62
19	68·75	68·00	68·27	71·60a	73·12	71·72	69·78	68·88	68·33	67·93	68·04	68·88
20	68·75	67·87	68·23	71·74a	73·39	71·91	69·74	68·84	68·30	67·86*	68·07	68·98
21	68·97	68·23	67·91	71·51a	73·44	71·93	69·71	68·84	68·29	68·03	68·05	68·96
22	68·49	68·63	67·83	71·16*	73·30	71·74	69·67	68·81	68·29	68·16	67·96	69·05
23	68·25	68·73	67·82	71·29	73·14	71·56	69·62	68·78	68·29	68·24	67·93	68·92
24	68·55	68·76	67·70	71·84*	73·01	71·36	69·63	68·76	68·28	68·26	68·03	68·79
25	68·63	68·64	67·63	71·88	72·90	71·22	69·62	68·72	68·26	68·23	68·09	68·96
26	68·39	68·50	67·53	71·90	72·78	71·17	69·59	68·73	68·25	68·29	67·97	69·15
27	68·39	68·20	67·49	71·87	72·59	71·06	69·55	68·72	68·22	68·41	68·08	69·30
28	68·53	68·11	67·53	71·87	72·42	70·95	69·48	68·72	68·18	68·46*	68·25	69·41
29	68·90	68·28	67·87	71·89	72·31	70·83	69·39	68·69	68·16	68·41	68·15	69·66
30	69·14	. ...	68·66	71·91	72·21	70·74	69·39	68·66	68·18	68·38	68·10	69·87
31	69·32	. .	69·55	...	72·14	.....	69·42	68·64	.....	68·39	.....	70·13
Mean	68·91	68·77	68·12	71·30	72·44	71·48	69·94	68·96	68·35	68·11	68·08	68·66

DAILY MEAN water surface elevations of lower St. Lawrence river, at Verdun, Que for 1916. Elevations are above mean sea-level and are referred to B.M. "V" on Bennett's house opposite wharf. Elevation 58.07.

1	34·81	39·81	42·81a	43·48a	35·95a	36·08	35·43a	34·85	34·53	34·28	34·38	34·47a
2	35·06	39·78	43·31a	44·60a	36·04a	36·03	35·45a	34·79	34·52	34·29	34·41	34·43a
3	35·11	39·69	43·81a	45·56a	36·08a	35·97	35·45a	34·74	34·47	34·30	34·39	34·38a
4	35·10	39·63	44·43a	44·93a	36·28a	35·95	35·45a	34·75	34·44	34·29	34·37	34·38a
5	35·03	39·61	44·68a	44·39a	36·33a	35·98	35·45a	34·74	34·47	34·28	34·29	34·38a
6	35·04	39·70	44·43a	44·89a	36·37a	35·97	35·37a	34·68	34·45	34·28	34·29	34·38a
7	35·11	39·91	44·06a	44·31a	36·37a	35·89	35·37a	34·69	34·44	34·27	34·29	34·47a
8	35·12	40·23	43·98a	44·06a	36·37a	35·80	35·33a	34·69	34·44	34·21	34·29	34·47a
9	35·14	40·57	44·06a	43·97a	36·37a	35·76	35·28a	34·72	34·45	34·24	34·33	34·55a
10	35·15	40·00*	44·14a	43·97a	36·28a	35·77	35·28a	34·79*	34·40	34·25	34·37	34·55a
11	36·07	.....	44·06a	42·89a	36·28a	35·74	35·20a	34·77	34·42	34·21	34·37	34·55a
12	36·58*	.....	44·06a	41·02a	36·28a	35·75	35·20a	34·73	34·44	34·20	34·33	34·55a
13	35·87	.....	44·39a	40·77a	36·28a	35·73	35·11a	34·65	34·45	34·24	34·27	34·63a
14	36·40	.....	44·31a	40·89a	36·24a	35·66	35·13a	34·69	34·45	34·24	34·22	34·72a
15	38·24	41·89a	44·23a	41·27a	36·20a	35·64	35·13a	34·68	34·44	34·21	34·22	34·72a
16	39·95	42·15a	44·48a	.....	35·90*	35·59	35·13a	34·69	34·43	34·26	34·22	34·92a
17	41·26	42·06a	44·31a	.....	35·92	35·67	35·09a	34·67	34·39	34·27	34·23	35·05a
18	41·62	41·99a	44·15a	38·20a	36·24	35·81	35·09a	34·64	34·42	34·30	34·25	35·22a
19	41·60	41·79a	44·31a	37·47a	36·63	35·90	35·05*	34·62	34·41	34·25	34·29	35·55a
20	41·52	41·89a	44·56a	36·70a	36·84	36·00	35·02	34·55	34·39	34·23	34·29	35·83a
21	41·14	42·44a	44·93a	36·28a	36·87	36·04	35·00	34·59	34·40	34·30	34·29	35·88a
22	41·34	42·85a	44·77a	36·08a	36·83	35·96	34·97	34·61	34·39	34·35	34·26	35·88a
23	40·45	42·98a	44·56a	36·12a	36·73	35·84	34·90	34·59	34·38	34·38	34·22	35·88a
24	39·78	42·89a	44·64	36·28a	36·64	35·72	34·95	34·59	34·34	34·38	34·27	36·01a
25	39·80	42·73a	44·77a	36·28a	36·59	35·59	34·96	34·57	34·35	34·38	34·34	38·59a
26	39·88	42·89a	44·56a	36·12a	36·52	35·59	34·94	34·56	34·34	34·41	34·34	38·42a
27	39·75	42·98a	44·43a	36·03a	36·39	35·56	34·91	34·54*	34·32	34·44	34·34	40·05a
28	39·76	42·69a	43·93a	35·95a	36·26	35·52*	34·89	34·57*	34·32	34·45	34·34	.....
29	39·74	42·81a	43·75a	35·98a	36·21	35·53a	34·83	34·55	34·33	34·42	34·33	42·17a
30	39·71	.....	43·60a	36·03a	36·16	35·51a	34·78	34·54	34·34	34·42	34·27*	42·17a
31	39·72	.....	43·39a	.....	36·15	.....	34·85	34·54	.....	34·43	. .....	42·17a
Mean	38·09	41·44	44·19a	40·16a	36·34	35·79	35·13	34·66	34·41	34·31	34·30	36·05a

*Denotes mean of less than twenty-four hourly readings. a Denotes mean of two staff Gauge readings.

DAILY MEAN water surface elevations of lower St. Lawrence river, at Montreal (foot of Lachine canal) Que. for 1916. Elevations are above mean sea-level and are referred to B.M. 637., Elevation 36.46.

Day.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	21·06				26·92	26·55	23·99	21·76	20·46	20·05	20·83	20·56
2	22·32				26·96	26·35	23·81	21·55	20·53	20·01	20·72	20·50
3	23·59				27·21	26·08	24·09	21·37	20·34	19·98	20·69	20·35
4	23·82				27·14	26·12	24·11	21·37	20·25	19·91	20·56	20·25
5	24·79				27·19	26·16	23·86	21·34	20·42	19·74	20·46	20·22
6	26·49				27·21	26·39	23·57	21·36	20·32	19·69	20·23	20·32
7	27·02				27·17	26·36	23·41	21·22	20·25	19·63	20·27	20·68
8	28·26*				27·12	26·18	23·34	21·25	20·23	19·51	20·26	20·75
9	29·10				27·08	26·05	23·13	21·62	20·28	19·75	20·24	20·72
10	30·55				26·90	26·03	22·92	21·50	20·19	19·67	20·36	20·62
11					26·51	25·89	22·72	21·55	20·18	19·57	20·41	20·83
12					26·57	25·68	22·59	21·52	20·17	19·61	20·41	21·18
13					26·51	25·48	22·63	21·41	20·24	19·52	20·41	20·80
14					26·33	25·27	22·67	21·33	20·38	19·86	20·33	20·53
15					26·30	24·92	22·49	21·30	20·42	19·60	20·04	20·60
16					26·14	24·89	22·27	21·28	20·35	19·82	19·97	21·07
17					26·39	25·28	22·54	21·24	20·13	20·17	19·94	21·54
18					26·95	25·71	22·69	21·13	20·11	20·08	19·80	22·26
19					27·82	25·84	22·63	21·04	20·10	20·00	19·75	23·46
20					28·28	26·03	22·51	20·87	20·00	19·99	19·97	24·79
21					28·51	26·18	22·41	20·80	19·91	19·94	19·91	26·17
22					28·48	26·05	22·24	20·77	19·87	20·14	19·62	27·20
23					28·15	25·74	22·06	20·67	19·97	20·36	19·67	27·97*
24					28·08	25·41	22·00	20·65	19·89	20·50	19·65	
25					27·94	25·00	21·92	20·52	19·96	20·45	19·98	
26					27·71	24·81	21·87	20·52	19·92	20·33	20·02	
27					27·47	24·69	21·92	20·47	19·85	20·67	20·04	
28					27·09	24·54	21·86	20·52	19·87	20·83	20·32	
29				26·75*	26·89	24·36	21·64	20·47	19·96	20·80	20·64	
30				26·85	26·81	24·20	21·54	20·48	20·19	20·79	20·55	
31					26·81		21·68	20·52		20·94		
Mean					27·18	25·61	22·68	21·07	20·16	20·06	20·20	21·88

DAILY MEAN water surface elevations of lower St. Lawrence river, at Laurier Pier (Montreal, Que.) for 1916. Elevations are above mean sea-level and are referred to B.M. 637. Elevation, 36.46.

1								20·59	19·29	18·99	19·72	19·45
2								20·39	19·37	18·94	19·58	19·40
3								20·20	19·23	18·90	19·55	19·34
4								20·19	19·12	18·82	19·50	19·20
5								20·17	19·28	18·64	19·36	19·18
6								20·21	19·19	18·59	19·13	19·18
7								20·05	19·10	18·51	19·17	19·57
8								20·08	19·08	18·37	19·15	19·66
9								20·47	19·13	18·61	19·10	19·68
10								20·32	19·10	18·51	19·20	19·54
11								20·38	19·07	18·43	19·29	19·72
12								20·36	19·03	18·50	19·31	20·12
13								20·30	19·11	18·39	19·29	19·75
14								20·17	19·25	18·74	19·26	19·48
15								20·16	19·30	18·49	18·97	19·53
16								20·13	19·25	18·68	18·90	20·08
17								20·09	19·04	19·04	18·83	20·69
18								19·99	19·00	18·96	18·66	21·51
19								19·90	18·98	18·89	18·58	22·76
20								19·75	18·86	18·88	18·82	24·21
21								19·65	18·77	18·81	18·77	25·68
22								19·59	18·73	19·00	18·51	26·49*
23								19·47	18·83	19·22	18·52	
24							20·74*	19·46	18·79	19·36	18·48	
25							20·68	19·32	18·83	19·32	18·77	
26							20·74	19·35	18·80	19·15	18·87	
27							20·68	19·32	18·73	19·51	18·88	
28							20·47	19·34	19·75	19·69	19·16	
29							20·37	19·30	18·85	19·71	19·56	
30							20·49	19·31	19·09	19·68	19·47	
31								19·35		19·82		
Mean							20·16	19·91	19·03	18·94	19·08	20·65

*Denotes mean of less than twenty-four hourly readings.

DAILY MEAN water surface elevations of lower St. Lawrence river, at Longue Pointe, Que., for 1916. Elevations are above mean sea-level and are referred to copper plug B.M. in S.E. corner of Asylum pump house. Elevation 40.477.

Day.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	20·20				25·77	25·23	22·53	20·29	19·01	18·73	19·54	19·30
2	21·59				25·76	25·02	20·36	20·10	19·09	18·67	19·38	19·25
3	22·89				26·00	24·75	22·65	19·91	18·95	18·63	19·34	19·14
4	23·13				25·93	24·80	22·68	19·91	18·84	18·55	19·22	19·03
5	24·14				25·99	24·82	22·43	19·89	18·99	18·38	19·14	18·99
6	25·84				26·01	25·06	22·15	19·91	18·91	18·29	18·91	19·01
7	26·16				25·96	25·07	21·94	19·76	18·82	18·23	18·95	19·39
8	26·37				25·90	24·92	21·87	19·78	18·80	18·12	18·93	19·49
9	26·88				25·80	24·79	21·67	20·18	18·86	18·35	18·90	19·51
10	27·16				25·62	24·77	21·43	20·03	18·82	18·27	18·98	29·39
11					25·16	24·61	21·22	20·10	18·80	18·18	19·06	19·54
12					25·18	24·36	21·06	20·09	18·76	18·25	19·09	19·91
13					25·15	24·12	21·11	20·02	18·82	18·19	19·06	19·60
14					24·99	23·91	21·15	19·90	18·96	18·50	19·07	19·33
15					24·99	23·57	21·01	19·89	19·03	18·27	18·78	19·36
16					24·83	23·50	20·88	19·85	18·96	18·44	18·70	
17					25·11	23·89	21·12	19·81	18·76	18·82	18·61	
18					25·67	24·34	21·33	19·70	18·70	18·73	18·45	
19					26·52	24·43	21·27	19·62	18·68	18·66	18·36	
20					27·08	24·62	21·13	19·46	18·56	18·67	18·56	24·14
21					27·26	24·77	21·01	19·35	18·47	18·59	18·51	25·60
22					27·23	24·63	20·85	19·30	18·44	18·78	18·23	26·50*
23					26·90	24·33	20·66	19·20	18·54	19·00	18·25	
24					26·81	24·00	20·56	19·18	18·50	19·14	18·24	
25					26·67	23·58	20·46	19·04	18·55	19·12	18·54	
26					26·42	23·36	20·40	19·06	18·51	18·94	18·57	
27					26·19	23·21	20·45	19·05	18·45	19·29	18·61	
28					25·83	23·06	20·39	19·07	18·48	19·48	18·99	
29					25·57	22·88	20·20	19·02	18·58	19·50	19·40	
30					25·49	22·72	20·10	19·03	18·81	19·48	19·33	
31					25·48		20·20	19·08		19·61		
Mean					25·91	24·24	21·23	19·63	18·75	18·71	18·86	20·36

DAILY MEAN water surface elevations of lower St. Lawrence river, at Varennes, Que., for 1916. Elevations are above mean sea-level and are referred to crow's foot B.M. on stone wall in rear of wharf. Elevation 31.97.

1					24·57	23·91	21·05	18·63*	17·32	17·19	18·09	
2					24·63*	23·71	20·88	18·44*	17·31	17·12	17·89	
3					24·80	23·47	21·16	18·32	17·26	17·06	17·83	
4					24·73	23·47	21·22	18·31	17·13	16·97	17·70	
5					24·77	23·49	20·97	18·29	17·26	16·75	17·63	
6					24·77	23·77	20·66	18·30	17·25	16·64	17·39	
7					24·73	23·83	20·43	18·14	17·15	16·59	17·43	
8					24·64	23·68	20·32	18·14	17·10	16·45	17·42	
9					24·53	23·54	20·13	18·56	17·16	16·68	17·38	
10					24·33	23·49	19·89	18·43	17·17	16·64	17·42	
11					23·87	23·31	19·68	18·52	17·15	16·56	17·53	
12					23·85*	23·04	19·49	18·51	17·10	16·67	17·59	
13					23·80	22·78	19·51	18·46	17·15	16·57	17·55	
14					23·67	22·56	19·56	18·32	17·30	16·87	17·57	
15					23·66	22·27	19·45	18·32	17·40	16·67	17·30	
16					23·52*	22·16	19·33	18·27	17·35	16·81	17·17	
17					23·85*	22·52	19·58	18·24	17·16	17·24	17·05	
18					24·35*	22·98	19·82	18·13	17·04	17·17	16·84	
19					25·34*	23·07	19·80	18·02	17·00	17·13	16·68	
20					25·77	23·24	19·61	17·84	16·87	17·14	16·89	
21					25·95	23·39	19·46	17·68	16·77	17·05	16·87	
22					25·93	23·25	19·28	17·61	16·72	17·21	16·57	
23					25·64	22·97	19·07	17·48	16·81	17·43	16·57	
24					25·53	22·61	18·94	16·47	16·80	17·61	16·60	
25					25·37	22·20	18·82	17·33	16·86	17·63	16·84	
26					25·11	21·94	18·75	17·35	16·85	17·41	16·94	
27					24·88	21·77	18·78	17·34	16·81	17·78	16·94	
28				24·36*	24·52	21·61	18·74	17·35	16·89	17·99		
29				24·37	24·26	21·41	18·58	17·32	16·99	18·07		
30				24·51	24·16	21·23	18·44	17·31	17·20	18·04		
31					24·14		18·51	17·38		18·16		
Mean					24·63	22·89	19·67	17·99	17·08	17·14	17·25	

*Denotes mean of less than twenty-four hourly readings.

DAILY MEAN water surface elevations of lower St. Lawrence river, at Verchères, Que., for 1916. Elevations are above mean sea-level and are referred to crow's foot B.M. on old windmill near wharf. Elevation 30.78.

Day.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1					23·44	22·71	19·78	17·30	16·02	15·98	16·89	16·63
2					23·43	22·52	19·62	17·15	16·09	15·92	16·67	16·60
3					23·61	22·29	19·91	16·96	15·97	15·82	16·57	16·40
4					23·55	22·25	19·97	16·97	15·86	15·72	16·42	16·26
5					23·60	22·28	19·73	16·97	15·99	15·50	16·36	16·21
6					23·57	22·58	19·41	17·97	15·95	15·36	16·13	16·21
7					23·50	22·66	19·16	16·80	15·85	15·29	16·17	16·55
8					23·41	22·54	19·05	16·78	15·78	15·17	16·18	16·66
9					23·27	22·38	18·84	17·25	15·85	15·40	16·15	16·77
10					23·06	22·30	18·58	17·10	15·88	15·38	16·18	16·62
11					22·61	22·09	18·35	17·21	15·89	15·32	16·31	16·67
12					22·51	21·80	18·17	17·22	15·84	15·45	16·32	17·12
13					22·47	21·55	18·20	17·17	15·92	15·39	16·31	16·88
14					22·35	21·35	18·26	17·04	16·08	15·66	16·36	16·58
15					22·34	21·08	18·18	17·06	16·19	15·46	16·08	16·57
16					22·27	20·96	18·09	17·00	16·12	15·59	15·92	16·96
17					22·61	21·27	18·34	16·95	15·92	16·02	15·78	17·67
18					23·12	21·69	18·64	16·84	15·77	15·93	15·51	18·87
19					23·91	21·79	18·61	16·72	15·70	15·88	15·29	20·43
20					24·45	21·97	18·42	16·54	15·56	15·91	15·49	22·22
21					24·66	22·03	18·23	16·35	15·44	15·81	15·48	23·88
22					24·69	21·96	18·03	16·25	15·42	15·95	15·22	24·69*
23					24·44	21·69	17·79	16·12	15·54	16·16	15·22	
24					24·28	21·35	17·63	16·10	15·54	16·34	15·30	
25					24·12	20·94	17·50	15·96	15·61	16·39	15·51	
26					23·85	20·65	17·40	16·00	15·59	16·17	15·69	
27				23·19*	23·64	20·47	17·43	16·00	15·56	16·50	15·76	
28				23·20	23·29	20·30	17·39	16·03	15·61	16·70	16·10	
39				23·25	23·01	20·13	17·25	16·00	15·73	16·81	16·66	
20				23·39	22·91	19·96	17·12	16·00	15·97	16·81	16·67	
31					22·91		17·18	16·07		16·91		
Mean					23·38	21·65	18·40	16·67	15·81	15·89	16·02	17·88

DAILY MEAN water surface elevations of lower St. Lawrence river, at Lanoraie Que., for 1916. Elevations are above mean sea-level and are referred to B.M. top of iron pin in hydrographic station at approach to wharf. Elevation 37.399.

1					21·84*	20·94	18·00	15·53	14·31	14·45	15·34	
2					21·80	20·76	17·89	15·40	14·36	14·37	15·09	
3					21·92	20·57	18·14	15·19	14·26	14·23	14·92	
4					21·87	20·47	18·21	15·17	14·12	14·11	14·78	
5					21·92	20·54	18·01	15·20	14·22	13·87	14·68	
6					21·87	20·86	17·69	15·18	14·19	13·66	14·46	
7					21·78	20·98	17·42	14·99	14·10	13·60	14·52	
8					21·66	20·91	17·27	14·97	14·03	13·49	14·57	
9					21·47	20·72	17·06	15·41	14·11	13·67	14·56	
10					21·24	20·58	16·80	15·35	14·18	13·74	14·56	
11					20·81	20·33	16·51	15·50	14·23	13·72	14·67	
12					20·61	20·03	16·41	15·54	14·21	13·87	14·67	
13					20·56	19·78	16·41	15·50	14·30	13·84	14·64	
14					20·48	19·61	16·49	15·38	14·46	14·03	14·72	
15					20·46	19·39	16·45	15·44	14·60	13·93	14·48	
16					20·44	19·25	16·41	15·38	14·52	13·99	14·26	
17					20·82	19·46	16·69	15·31	14·32	14·42		
18					21·31	19·85	17·07	15·19	14·11	14·37		
19					22·05	19·96	17·04	15·04	13·96	14·31		
20					22·56	20·12	16·83	14·84	13·80	14·35	13·67*	
21					22·79	20·22	16·59	14·58	13·67	14·29	13·64	
22					22·82	20·11	16·36	14·44	13·65	14·36	13·40	
23					22·61	19·87	16·08	14·31	13·79	14·54	13·39	
24					22·41	19·55	15·87	14·27	13·84	14·73	13·57	
25					22·21	19·17	15·72	14·15	13·92	14·83	13·73	
26					21·97	18·85	15·61	14·19	13·90	14·62		
27					21·76	18·64	15·62	14·22	13·91	14·89		
28					21·43	18·48	15·60	14·27	13·98	15·11		
29					21·17	18·33	15·50	14·25	14·11	15·25		
30					21·05	18·16	15·37	14·25	14·36	15·27		
31					21·08		15·39	14·33		15·33		
Mean					21·57	19·88	16·66	14·93	14·12	14·30	14·39	

*Denotes mean of less than twenty-four hourly readings.

DAILY MEAN water surface elevations of lower St. Lawrence river, at Sorel, Que., for 1916. Elevations are above mean sea-level and are referred to C.B.M., MCCCVII on N.W. side of entrance to Post Office. Elevation, 46.80

Day.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1					21·15	20·26	17·37	14·97	13·86	14·05	14·86	14·76
2					21·16	20·08	17·27	14·89	13·90	13·97	14·62	14·71
3					21·24	19·89	17·50	14·70	13·81	13·82	14·42	14·49
4					21·18	19·77	17·56	14·68	13·66	13·68	14·25	14·30
5					21·21	19·87	17·40	14·74	13·74	13·44	14·15	14·25
6					21·17	20·19	17·09	14·69	13·73	13·21	13·95	14·31
7					21·07	20·31	16·80	14·51	13·63	13·15	14·02	14·53
8					20·92	20·27	16·64	14·49	13·57	13·05	14·04	14·66
9					20·72	20·07	16·44	14·89	13·65	13·21	14·10	14·81
10					20·48	19·89	16·20	14·86	13·73	13·32	14·07	14·66
11					20·06	19·63	15·97	15·02	13·78	13·30	14·17	14·64
12					19·83	19·35	15·80	15·07	13·79	13·45	14·18	14·97
13					19·78	19·10	15·82	15·05	13·88	13·46	14·13	14·96
14					19·72	18·95	15·90	14·94	14·03	13·64	14·19	14·64
15					19·71	18·75	15·89	14·99	14·17	13·50	14·00	14·55
16					19·70	18·62	15·85	14·94	14·12	13·56	13·77	15·36
17					20·07	18·77	16·16	14·86	13·89	13·98	13·50	16·41
18					20·56	19·10	16·57	14·75	13·67	13·93	13·20	17·05
19				20·77*	21·27	19·26	16·52	14·59	13·51	13·85	12·93	16·99
20				20·72	21·76	19·39	16·30	14·39	13·34	13·88	13·08	16·85
21				20·70	21·98	19·49	16·05	14·11	13·20	13·84	13·11	16·87
22				21·28	22·05	19·39	15·81	13·96	13·19	13·89	12·89	17·09
23				20·95	21·85	19·16	15·52	13·83	13·33	14·06	12·91	17·62
24				20·82	21·64	18·86	15·30	13·79	13·41	14·24	13·10	17·56
25				20·76	21·43	18·50	15·15	13·69	13·49	14·36	13·29	17·37
26				20·80	21·19	18·19	15·02	13·72	13·47	14·17	13·56	17·53
27				20·84	20·99	17·86	15·03	13·76	13·48	14·40	13·66	17·11
28				20·86	20·69	17·80	15·02	13·81	13·58	14·61	13·98	17·24
29				20·94	20·45	17·65	14·93	13·79	13·73	14·74	14·65	17·47
30				21·08	20·32	17·50	14·81	13·79	13·94	14·78	14·80	17·40
31					20·35		14·82	13·88		14·84		17·27
Mean					20·83	19·20	16·08	14·46	13·68	13·85	13·85	15·88

DAILY MEAN water surface elevations of lake St. Peter, at Range Light No. 2, for 1916. Elevations are above mean sea-level and are referred to brass plug B.M. on north side of pier. Elevation, 18.33 (W.S. Transfer of 1916).

1						19·08	16·03	13·37*	12·39		13·65*	
2						18·87	15·95	13·40*	12·42		13·48	
3						18·71	16·05	13·22	12·31		13·18	
4						18·57	16·19	13·19	12·12		12·96	
5						18·72	16·07	13·29	12·11		12·78	
6						18·98	15·75	13·15	12·14		12·71	
7						19·09	15·45	12·97	12·06		12·78	
8						19·03	15·22	12·94	12·02	11·55*	12·90	
9						18·85	15·02	13·23	12·11	11·69	12·98	
10					19·24*	18·58	14·77	13·36	12·21	11·94	12·96	
11					19·01	18·37	14·57	13·54	12·30	11·93	12·95	
12					18·66	18·10	14·42	13·66	12·39	12·09	12·96	
13					18·55	17·88	14·39	13·65	12·49	12·18	12·80	
14					18·45	17·72	14·50	13·60	12·62	12·30	12·89	
15					18·41	17·57	14·52	13·68	12·82	12·25	12·81	
16					18·42	17·43	14·54	13·58	12·78	12·20	12·48	
17					18·65	17·51	14·80	13·47	12·49	12·59	12·17	
18					19·39	17·83	15·28	13·34	12·21	12·61	11·90	
19					20·11	18·06	15·24	13·13	11·96	12·40*	11·60*	
20					20·54	18·16	15·02	12·90	11·72	12·52*		
21					20·83	18·25	14·70	12·55	11·58*	12·62		
22					20·88	18·14	14·43	12·35	11·61*	12·58		
23					20·74	17·91	14·10	12·23	11·78	12·73		
24					20·46	17·58	13·83	12·18	11·89	12·93		
25					20·23	17·25	13·67	12·11	11·97	13·10		
26					19·99	16·90	13·52	12·12	11·97	13·11		
27					19·75	16·62	13·48	12·24	12·00*	13·16		
28					19·49	16·45	13·49	12·29		13·37		
29					19·26	16·30	13·47	12·31		13·50		
30					19·10	16·16	13·34	12·29		13·58		
31					19·11		13·31	12·39		13·67*		
Mean					19·47	17·96	14·68	12·96	12·17	12·61	12·79	

*Denotes mean of less than twenty-four hourly readings.

CANADIAN ARCTIC EXPEDITION.

The Canadian Arctic Expedition, under the leadership of Vilhjalmur Stefansson, set out for the Arctic regions on the 20th July, 1913.

The work planned comprised the exploration of Beaufort sea, the investigation of animal life in the areas covered, and the taking of soundings over the regions explored. The expedition was also to ascertain if lands hitherto unknown exist, and to definitely mark any found. The investigating and areal mapping of the copper-bearing and associated rocks of the mainland between cape Parry and Kent peninsula for approximately one hundred miles inland, and of the southern and eastern shores of Victoria island were also to be undertaken.

The work was so varied both in the nature of the investigations and the area to be explored that it was decided to divide the expedition into two parties; one, known as the Northern division, to carry out the Beaufort sea work; the other, known as the Southern division, to work on the coast survey.

SOUTHERN DIVISION.

The Southern division have completed the work and have returned from the north. A complete report of operations by Dr. R. M. Anderson, executive head of the Southern division, is appended hereto.

NORTHERN DIVISION.

The Northern division, in C.G.S. *Karluk*, sailed from Nome, Alaska, on the 20th July, 1913. Shortly after rounding point Barrow the vessel became ice-bound. It was carried eastward along the coast to near Thetis island, where it became stationary and was apparently frozen in for the winter. Mr. Stefansson, accompanied by B. M. McConnell, George H. Wilkins, and D. Jenness, set out on a hunting trip to the mainland. During their absence the vessel was carried away and the hunting party were obliged to make their way westward along the coast to Collinson point, where they joined the Southern division, who were wintering there.

The *Karluk* was carried far to the westward, and on the 11th January, 1914, was crushed by the ice, and sank. The men in the vessel transferred supplies, ammunition and other necessities to the quarters prepared on the ice, and they settled down in their igloos to await the return of the light.

Some of the men were not satisfied with the inaction of life in the camp, and expressed a desire to set out for land, dimly visible in the Arctic twilight. Two parties were therefore formed, each composed of four men, and set out for land, the first party on the 21st January and the second on the 5th February. These men have not since been heard from, and have been given up for lost.

When the light had improved the remaining members set out for land and succeeded in reaching Wrangel island. Through the efforts of Captain R. A. Bartlett, who journeyed on foot to the Siberian coast and thence to East cape, to get in touch with the outside world, a relief expedition was organized and the men were rescued from the island.

The following men were lost in attempting to reach Wrangel island: Charles Barker, John Brady, Alex. Anderson, A. King, Dr. F. MacKay, James Murray, H. Beauchat, and T. S. Morris. B. Mamen and G. Malloch died from nephritis on Wrangel island, and George Breddy was accidentally shot.

The survivors were John Munro, R. Williamson, W. McKinley, F. E. Maurer, John Hadley, R. Templeman, H. Williams and E. F. Chafe.

ICE EXPEDITIONS.

Immediately upon his arrival at Collinson point, Mr. Stefansson began preparations for a trip on foot over Beaufort sea to the north. Although the fate of the *Karluk* was not then known, he realized that, owing to ice conditions, the party therein would probably be unable to carry out the exploration work. He purchased the *North Star*, partly for the supplies which went with the vessel, and also for the use of the vessel itself.

On the 22nd March, 1914, the ice party, composed of V. Stefansson, Storker T. Storkerson, and Aurnout Castel, set out. Their intention was to continue as far out across the ice as circumstances would permit and, if possible, to land on Banks or Prince Patrick island, where they would spend the summer. In the event of their failing to return before the break up of the ice, a vessel was to be sent to Banks island during the summer.

On the journey across the ice the party covered an area previously unexplored, and travelled as far to the west of Banks island as safety would permit. When the ice began to break up, toward the end of April, the party were obliged to make for land. They landed on Norway island on the northwest coast of Banks island on the 25th June.

The summer was spent in mapping the coast line of Northern Banks island and in carrying on investigations in the interior of the island, up the "Wilkins" river; this river empties near Norway island.

In September, 1914, the party travelled south to Kellett, where George H. Wilkins and a party in the *Mary Sachs*, sent north with supplies were met. A winter base was established at Kellett, and the *Sachs* was beached. The Vessel was considerably damaged on the way north, and required repairs.

On the 22nd December, 1914, Mr. Stefansson, accompanied by an Eskimo, Natkusiak, made a journey across southern Banks island to DeSalis bay to locate any Eskimos wintering in that vicinity. Before leaving he gave instructions to the party at Kellett to prepare for an ice trip over Beaufort sea, to begin early in February. He arrived at DeSalis bay on the 3rd January, 1915, and crossing over Prince of Wales strait followed the shore of Victoria island for some miles. Finding no indications of the presence of Eskimos he returned to Kellett, arriving on the 27th January.

Preparations for the ice trip having been almost completed during his absence, the few remaining details were arranged, and the party, composed of V. Stefansson, Storker Storkerson, Ole Andreasen, and Charles Thomsen set out north for cape Alfred early in February, following the west coast of Banks island. From cape Alfred they journeyed in a northwesterly direction until the 26th April, when the break up of the ice obliged them to make for Prince Patrick island. They landed on Prince Patrick island near Land's End, and thence followed the shore northeast to cape McClintock. They proceeded for three days north from this point, when land unmarked on the charts was discovered. A complete report, giving details of the journey, is contained in the Naval Service Annual Report of March 31, 1916. Owing to the lateness of the season and the necessity for arranging the next season's work, the party set out on the return journey without carrying on any extensive investigations. They arrived at Kellett on the 8th August.

On the 19th August the *Polar Bear*, in charge of Captain Lane, arrived at Kellett. As the services of a vessel were urgently required by the Northern division (the *Mary Sachs* had not been relaunched), Mr. Stefansson purchased the *Bear*, and set out for Baillie island. Upon arrival there he left instructions for the *North Star*, for which Mr. Wilkins had gone to the base of the Southern party on foot early in the spring, to go to Banks island without communicating with him. He returned to Kellett, whence he set out for the north in the *Bear* on the 3rd September.

It was intended at first to land at Kellett and proceed north along the west coast of Banks island. Up to this time, since late July, the coast had been kept free from ice by prevailing easterly winds, but on the 3rd September the wind changed and blew from the northwest, with a heavy fall of snow. Upon reaching cape Kellett it was seen that the ice was coming in, and the party took shelter behind the cape for the night. By the morning the ice was pressed close to the west coast, debarring further progress. Fearing that with a slight change of the wind they might be shut in, Mr. Stefansson decided to make an attempt to get north through Prince of Wales strait, along the east coast of Banks island. It has since been learned that the freeze-up on the west coast of Banks island came on the 6th September, and the ice did not leave the coast until the spring of 1916.

A course was set for Nelson head, which was rounded on the night of the 4-5th September and the vessel proceeded north into the straits. South of N. Latitude 72° only scattered ice was encountered, but north of 72° there were large packs of heavy ice called "paleocrystic", that is, ice that has lasted through several summers, during which time it has been freed from most or all of its salt and become hard and glare. On September 5 there was a strong southeast wind which kept the water along the Victoria island coast free of ice, and on the night of the 5th the party took shelter near the land just south of Deans Dundas bay. On the 6th September considerable time was lost in navigating through scattered ice, and during the afternoon the wind changed to the west, bringing down heavy masses of ice from the Banks island side. They were able to proceed only as far as Princess Royal island, where the vessel was tied up for the winter and the party prepared to make their winter quarters there.

As soon as it was decided to winter near Princess Royal island the party set out to obtain as much caribou meat as possible, but as it was past the season for caribou, which had already gone south, only twenty-three were obtained. All the drift-wood that could be found within 15 miles on either side of the winter quarters was gathered. A base was established some 10 miles southwest of Armstrong point. This base was in an ideal location to complete the mapping of the northeast coast of Victoria island. Mr. Stefansson instructed Storker Storkerson to undertake this survey as soon as the ice would become frozen over sufficiently to enable them to travel.

The land east of the base near Armstrong point is high and rocky, so that crossing it by sled in the early fall would not be practicable. The survey party were therefore obliged to wait until Melville sound north of Peel point froze over, which did not happen until the middle of October.

On the 10th October the party left camp, Storkerson and Herman Kilian to make the complete trip, Noice and Andreasen for the supporting party. At Hornby point on the 24th October the supporting party turned back. Storkerson and Kilian returned on the 4th December without having been able to quite complete the work, but an effort was to be made to complete it in the spring of 1916.

During the survey the chief difficulties encountered were darkness and continual gales. At one point the party were stormbound for twelve successive days by a head gale which the dogs would not face. Drawings of the hitherto unexplored coast line covered were made by Mr. Storkerson, and will be published with the final report of operations.

Mr. Stefansson himself made several trips during the autumn of 1915. The first trip was for hunting purposes, on which he was accompanied by natives, whom he established in a sealing camp at Hay point. Later on this camp was moved to Ramsay island, and in November he made a trip south, following the curves of the coast until he found a party of Eskimos, numbering about

one hundred, in Minto inlet, south across the neck of land from the foot of Walker bay. Two of the Eskimos returned with the party to the *Polar Bear*, Captain Gonzales later made a trip to the village for trading purposes, but considerable difficulty arose owing to the natives not having been accustomed to dealing with white men. Unfortunately, the natives contracted severe colds about the same time that the party from the *Polar Bear* visited them, and they superstitiously attributed their sickness to the presence of the white men. Should any of them die from cold or hunger resulting through their being unable to obtain game through illness, their white visitors would be blamed and the natives would refuse to trade further with them. Mr. Stefansson, however, did all in his power to overcome this friction between the natives and the *Polar Bear* party, and no serious results occurred.

On the 1st December, Mr. Stefansson left Ramsay Island hunting camp for Kellett. The chief purpose of this trip was to get two sleds which Captain Beneard was making for use on the ice trip the following spring. The party consisted of Stefansson, Noice, Martin Kilian, and an Eskimo. On the first part of the journey many difficulties were encountered. The party intended to follow the south coast of Banks island around as far as DeSalis bay and thence cross to the west coast by practically the same route as that used by Mr. Stefansson the previous winter in his journey across southern Banks island. Before reaching the Banks island coast, however, they broke the runner of one of the sleds, thus making it necessary to put a double load on the remaining sled. In order to avoid a second accident of this nature they decided to cross overland the whole way, as the going was smoother than on the sea ice. On this journey they were further handicapped by the death of their best dog. This dog was capable of drawing three hundred pounds, while the average dog is capable of drawing only between two hundred and two hundred and fifty pounds. In Mr. Stefansson's opinion the ice journeys for the summer of 1916 would be considerably shortened by the loss of this animal.

On the journey across Banks island it was ascertained that the map, as given in Admiralty chart No. 2118, is somewhat out on the southeast coast. This chart calls for a width of about thirteen miles due west between Ramsay island and Banks island, while in reality the distance is at least twenty-five miles. The error seems to be that this whole portion of Banks island should be moved north on the map until Milne point is nearly where Schuyler point is now placed. The party climbed the slope of Banks island from the first bay indicated north of Milne point. There really is no bay there, but only the low land at the mouth of a small river. They ascended the valley of this river for about ten miles. After the first four miles the river runs through a narrow and crooked ravine. Although the grade is considerable, the party were unable owing to the fog and blizzard, to obtain a definite idea of the exact elevation. Mr. Stefansson, however, judged that within ten miles from the coast they had attained an elevation of over four thousand feet. The journey across Banks island entailed a great amount of climbing up and down hills. The party finally came down into a river valley some seven or eight miles back of DeSalis bay. From the point where they came to it this river runs about south into the bay, but following up stream they went first north then northwest and finally about west some ten or twelve miles until the valley widened into a continuous flat, which extends to the ocean some forty-five miles southeast from the tip of cape Kellett. The slope of this flat is to the east until within some fifteen miles of the west coast. It is from one to four miles wide and is flanked by hills rising three hundred to five hundred feet over the lowland. For the last fifteen miles there is a river flanked by low banks, which are apparently water-swept each spring. This river comes into a small bay without any abrupt descent, so the party did not at first realize that they had reached the sea. On this journey it was found that by following this route there is a pass from DeSalis bay east through the high southern part of Banks

island without ascending to a height of more than three hundred feet. Although the actual elevations were not obtained, the knowledge of this pass will be of great value to any one needing to cross Banks island. The total distance, following the river that flows into DeSalis bay, is about thirty-five or forty- miles.

Upon their arrival at Kellett the party found all well at that base. They were told that the *North Star* was unable to proceed more than twenty miles beyond Norway island on the west coast of Banks island, as the ice north of that point did not move during the whole summer of 1915.

On the 6th January, Mr. Stefansson sent Thomsen, Noice, and Knight across Banks island to DeSalis bay en route to the *Polar Bear*, near Armstrong point. On the way they were to close up the hunting camps at Ramsay island. Thomsen carried a letter of instruction to Storkerson to assemble such things in the way of an outfit for the ice journey as were not provided by the *North Star* or *Sachs* and bring them with two dog teams to cape Alfred.

In the meantime the party at cape Kellett, under the immediate supervision of Mr. Stefansson, prepared for the journey to cape Alfred. These plans unfortunately did not materialize owing, in the first place, to delays experienced by Thomsen and party, who did not arrive at the *Polar Bear* until the first of February. These delays were caused by bad weather which prevented the party finding Ramsay island. For about five days they were in plain sight of it had the weather been clear. They also encountered open water about four miles beyond Milne point, which obliged them to considerably lengthen the trail. Storkerson, at the *Polar Bear*, had in the meantime much trouble getting from Mercy bay the sleds cached there the previous year. The chief obstacle was the mountainous character of the intervening land, which was practically uncrossable in the midwinter darkness, and through the roughness of the ice between point Russell and Mercy bay when that route was later adopted.

When Storkerson received the instructions sent by Mr. Stefansson the dogs were in poor condition for travel. On the journey up to point Russell in an endeavour to carry out the instructions received from Stefansson, Storkerson lost several dogs, which rendered continuation of the journey practically impossible. As he erroneously considered that Mr. Stefansson would prefer the failure of the ice trip to the failure to explore the new land, and as he considered that both could not be carried out with the dogs in such poor condition, he took upon himself to alter the plans and instead of going west started for the new land. Upon arrival, he commenced investigation of the new land, sending a sled in charge of Hermann Kilian to Mercy bay with a letter of information for Stefansson, which he would pick up on his way east.

In the meantime Mr. Stefansson and party were waiting for the arrival of Storkerson at cape Alfred. While they were waiting, hunting camps were established around cape Alfred in order to provide fresh meat for the ice trips planned. The party waited until the 7th March, when the season was already late to start on the ice. By this time considerable anxiety was felt on account of the non-arrival of Storkerson, as it was feared that Thomsen had failed to reach the *Bear* with instructions for him. On the 7th March, Stefansson started for Mercy bay to learn whether any of the men had visited the bay. The remainder of the party busied themselves in carrying supplies east to be used in the new-land work. The *Star* was temporarily abandoned and the party belonging to her were sent to Melville island to assist in the new-land work.

On the 20th March the Stefansson party met Castel a little east of cape McClure. He reported that he had been unable to recognize any point on the coast from the chart; that he had reached a bay which he thought might be Mercy bay and had gone ten miles into it, but finding no trace of sleds, and the dog feed having given out, he returned.

From Castel's observations and those of other parties it appears that for forty-five or fifty miles west of Mercy bay no point on the chart could be iden-

tified by the contour of the coast as shown on Admiralty chart No. 2118. It appears that the big bay shown by chart No. 2118 as just east of cape McClure does not exist, although there is a bay of considerable size about six miles west of Mercy bay. This unmarked bay is the one from which Castel turned back. On the west side of it he cached a fifty-gallon drum of kerosene which was intended generally for the use of the Eskimos of Melville island in the summer of 1916. On meeting Castel, who had seen no trace of Storkerson, Mr. Stefansson gave up hope of his arrival, and sent orders to cape Alfred to break camp and commence moving to Melville island.

He also left instructions that when established on Melville island the party were to put up dried meat for the winter supply.

At Mercy bay the letter left by Storkerson, explaining the reason for the change in plans, was found. From this letter Mr. Stefansson understood that by proceeding to cape Ross, Melville island, he could get in touch with Mr. Storkerson through men stationed there to protect supplies, or through travelling parties.

Mr. Stefansson, accompanied by Wilkins, Castel, Kilian, Natkusiak, and Emiu, with three sleds, accordingly proceeded to cape Ross, arriving there on the 13th April. The party found the remains of a camp, a small cache and a note from Storkerson saying he had gone towards the head of Liddon gulf, but there was little or no information which would aid them in co-operating with him.

As there has been a heavy fall of snow the party could not tell, from following the trail, how many sleds Storkerson had. It was therefore impossible to determine if he intended to return to cape Ross or proceed to the new land. Under the circumstances, Mr. Stefansson decided that the best plan would be to send one sled in charge of Natkusiak to the head of Liddon gulf, where the dogs could be well fed and rested, while he himself would make a quick journey back along the trail leading to the *Polar Bear* until they would come across information which would guide them. Before they proceeded far, however, they were met by Herman Kilian, who had come directly from the Storkerson party. Kilian reported that Storkerson, with Thomsen, Andreasen, Noice, and Illun had left the head of Liddon gulf on the 14th April for the new land, intending to keep on advancing and to map as much country as possible so as to be home at the *Polar Bear* on the 10th July. Mr. Stefansson therefore decided to overtake Storkerson if possible as he planned to land at the north end of Melville island between the 15th and 20th July, which meant that his season of exploration work would be at least one month longer than Storkerson's. In case the new land proved extensive he did not purpose returning to Melville island, giving the whole summer to exploration work.

The party in charge of Stefansson left cape Ross for the north on the 19th April. They reached the head of the gulf in three days, crossed the portage near point Nias, and arrived at the new land on the 2nd May at the same point as the previous year. They met Storkerson on the 3rd May at cape James Murray, which appears to be the southwest corner of the new land. Arrangements were immediately made to carry out exploration and charting work. Thomsen, with one team, was sent to Kellett to carry scientific specimens from the *North Star* to the *Mary Sachs*, and also to carry the reports of the expedition to Kellett in order that they might be sent out by the first ship calling there.

The department has received no later reports from Mr. Stefansson. It is expected that a complete survey of the newly discovered land will be made, and that journeys over the ice to the west, covering parts of Beaufort sea hitherto unvisited, may be carried out. It would appear that Mr. Stefansson does not intend to leave the region until every detail of the work planned has been completed.

THE CANADIAN ARCTIC EXPEDITION OF 1913.

REPORT OF THE SOUTHERN DIVISION.

The Deputy Minister,
Department of the Naval Service,
Ottawa.

SIR,—I have the honour to submit a report upon the work of the Southern Division of the Canadian Arctic Expedition of 1913-16.

The Canadian Arctic Expedition of 1913-16 was planned to work in two comparatively distant and distinct fields, and the nature of the investigations to be undertaken was so varied that the expedition was divided into two parties.

The Northern party, under command of Mr. Vilhjalmur Stefansson, were to explore the Beaufort sea and also carry on investigations into the animal life of this region and take soundings in the districts investigated. They were also to ascertain if islands hitherto unknown exist, and to definitely mark any found. This division of the expedition was thus to confine its work largely to the oceans and archipelagos north of Alaska and the Western Arctic region of Canada.

The work of the Southern party, under my direction, was to be confined more exclusively to the Arctic mainland and adjacent islands, as set forth in the following instructions:—

> "The relative importance of the investigations for this party are: (1) geological, (2) geographical, (3) anthropological, (4) biological, (5) photographical.
>
> "The work of the Southern party shall be primarily the investigation and areal mapping of the copper-bearing and associated rocks of the mainland between cape Parry and Kent peninsula and for approximately one hundred miles inland and on southern and eastern Victorialand.
>
> "The work undertaken by these parties should be of a high order for this class of exploration, and should mark a distinct advance over previous work. To secure such results the geological and topographical sub-parties should follow closely the regular scheme for field parties engaged in reconnaissance work adopted by the Geological Survey. In working from the base depot, these parties should be practically complete distinct and independent units. . . . The anthropological work shall consist of ethnological and archaeological research. . . . The biological work shall consist of marine and terrestrial biology, etc., etc."
>
> The chief of the southern party, as executive head, must afford every reasonable facility as circumstances permit to enable these sub-parties to carry out the above important work."

Ample provision was made for the scientific work of the party by selecting competent specialists for each branch of science to be studied, and providing them with all necessary instruments and such equipment and provisions as had by experience been found most suitable for use under the climatic conditions expected. The scientific staff of the Southern party as originally organized was as follows: Geologist, John J. O'Neill, of Ottawa, who had specialized in Pre-Cambrian geology and copper rocks; topographers, Kenneth G. Chipman

and John R. Cox, men of several years' experience in the topographical division of the Geological Survey; anthropologists, D. Jenness, of New Zealand, an Oxford man with field experience in ethnology in New Guinea, and M. Henri Beuchat, of Paris, a writer of note on American archaeology; marine biologist, entomologist, and botanist, F. Johansen, a former member of the Danish East-Greenland Expedition of 1906-08 under Mylius Ericksen and later entomologist for the United States Department of Agriculture; meteorologist and magnetician, William Laird McKinlay, of Glasgow; photographer and cinematographer, George H. Wilkins, of Adelaide, Australia; mammalogist and ornithologist, Dr. Rudolph Martin Anderson, of the Victoria Memorial Museum of Ottawa. The latter, having had several years previous experience in exploratory work in Arctic, Alaska, Yukon Territory, and the Northwest Territories, was appointed to take charge of the Southern party in the absence of Mr. Stefansson.

Owing to the unavoidable complications arising from the unfortunate drift and loss of the *Karluk*, M. Beuchat and Mr. McKinlay were unable to join the Southern party at Herschel island as contemplated, and Mr. Wilkins was only able to be with the Southern party for a part of the time. Mr. Jenness was able to cover much of the ethnological work as planned, by taking over part of M. Beuchat's field, and by division of labour of the whole party complete meteorological records were kept for nearly three years. The magnetic instruments were lost on the *Karluk*, and consequently that branch of science is lacking in the final results.

As the expedition was not formally taken up by the Dominion Government until February, 1913, the time was rather short for assembling the multitude of articles of supply and equipment required. Although most of the members of the scientific staff were members of the Geological Survey, the general direction of the expedition was in the hands of the Department of the Naval Service. With the exception of technical instruments and equipment supplied to certain members by the Geological Survey, practically the whole of the equipment, including provisions, clothing, field gear, etc., was supplied by the Department of the Naval Service.

Some difficulty was experienced in obtaining large quantities of pemmican, dehydrated vegetables, and other condensed foods on short notice, and a vast assortment of miscellaneous goods had to be provided, "everything from a needle to an anchor," as there was no certainty of being able for three years to replenish articles consumed or left behind. Practically everything requisitioned was assembled at H.M.C. Dockyard, Esquimalt, B.C., in June, 1913. The expedition is under great obligation to Mr. J. A. Wilson, Director of Stores, Department of the Naval Service, Ottawa, and to Mr. George Philips, Naval Store Officer, Esquimalt, B.C., for their efficiency and care in seeing that articles for the expedition were supplied promptly and of excellent quality, both at the start of the expedition and later, as well as for encouragement and friendly and intelligent co-operation with the work of the expedition outside of the extent of their official duties. George J. Desbarats, C.M.G., Deputy Minister, Department of the Naval Service, is also to be thanked for continued interest and prompt attention to the work and needs of the expedition throughout more than three years of our absence in the north. Through their efforts the Canadian Arctic Expedition was probably as completely and well equipped as any expedition that has ever gone into the north.

Most of the members of both the Northern and Southern parties of the expedition, with a large part of the equipment and supplies, sailed from Esquimalt, B.C., June 17, 1913, on the steam-whaler *Karluk*, which had been purchased for the use of the Northern party. Additional supplies were shipped from Victoria and Seattle to Nome on one of the Alaska Steamship Company's vessels. The *Karluk* arrived safely at Nome on July 9. The gasolene schooner *Alaska*, which had been built in 1912 for the Bering Sea trade and to carry

the United States mail to Kotzebue sound, had been under option for the use of the Southern party, and was purchased at Nome, Alaska. Its dimensions were: Length, 57 feet 5 inches; draught, 6 feet 6 inches; gross tonnage, 50; beam, 17 feet; construction, wooden auxiliary schooner; 50 horse-power standard gas engine.

Considerable additional supplies and equipment, including reindeer skins and skin clothing, sleds, dogs, distillate, coal oil, and a large supply of dried dog salmon, were obtained for the expedition at Nome. As the numbers of the party had been much increased over the originally planned number, with correspondingly increased equipment, the gasolene schooner *Mary Sachs* was also purchased in Nome as an auxiliary vessel for both parties. The *Mary Sachs* had the following dimensions: Length, 56 feet 6 inches; draught, 5 feet 6 inches; beam, 18 feet 1 inch; gross tonnage, 41; construction, wooden, gasolene, screw vessel; 30 horse-power Union gas engine.

The *Karluk* and *Mary Sachs* sailed from Nome July 20, and calling at port Clarence, sailed from there July 27. The C. G. S. *Alaska* left Nome on July 19, arriving at Teller, Alaska, July 24. Here it was found necessary to dismantle and overhaul the engine and put on a better propeller before proceeding farther. This involved discharging and reloading cargo, and the *Alaska* did not get away from port Clarence before August 11, rounded point Barrow August 20, and passed Flaxman island September 6. No ice was met until we were near the Seahorse islands, a little south of Barrow, Alaska, but east of point Barrow the prevailing westerly and northwesterly winds had packed the ice along the shore, so that there was very little open water anywhere. For the first time since 1888, when the whalers began going in to Herschel island annually, no vessel from the west was able to get in to Herschel island, and some small vessels which had spent the preceding winter east of Herschel island were unable to go out. The vessels caught between Herschel island included the 247-ton steamer *Karluk*, belonging to the expedition, the 420-ton steam-whaler *Belvedere*, the gasolene schooners *Polar Bear*, *Anna Olga*, *Elvira*, and *North Star*, the *Alaska* and *Mary Sachs* of the expedition, and the *Teddy Bear* east of the Mackenzie river. Of these the *Elvira* was crushed and sank in October, 1913, near Humphrey point, Alaska, and the *Karluk* drifted west and sank northeast of Wrangell island in January, 1914.

The ice encountered in Beaufort sea in 1913 was too heavy to be bucked successfully by any vessel, no matter of what strength of hull or power of engines. There are no true icebergs in the western Arctic ocean, such as are broken off from the peripheral glaciers of Greenland or the Antarctic continent. The immense sheets of flat ice which are formed, however, crack extensively with the rise and fall of the tides. These tide-cracks frequently open widely or close abruptly by the force of the winds, crushing the edges of the floe like glass, and forcing up great blocks to form pressure-ridges which may be 30 to 40 feet high. Snow-drifts fill up the crevices of the ridge, and as the snow melts and settles in the spring, the whole becomes cemented into a floe that is too massive to thaw in a single short summer season, and may last over for several years.

These large masses of ice in the shoal waters off the north coast of Alaska and Canada, if not too thick and numerous, are to a certain extent an advantage to small vessels, as they cut down the swell in heavy weather, and often ground in comparatively deep water some distance from shore, allowing vessels of small draught on a harbourless coast to tie up behind them, sheltered from winds and from ice crushing from outside. By creeping slowly along the shore, moving ahead a little whenever the wind and tide loosened and shifted the ice a little along the coast, the *Alaska* and the *Mary Sachs* succeeded in getting as far ahead as Collinson point, 69° 59′ N. Lat., 144° 50′ W. Long., in

Camden bay, on the north coast of Alaska, about ninety miles west of the Alaska-Yukon Territory international boundary, and decided to go into winter quarters at Collinson point on September 10, three or four days before the freeze-up.

The *Alaska* and *Mary Sachs* secured a sheltered harbour in a small bay behind the Collinson point sandspit; the vessels were unloaded, and the men secured comfortable quarters for the winter in a large log-house built of drift-wood. Large quantities of Mackenzie river driftwood on all the beaches of the north Alaska coast furnish abundant fuel. The cariboo have been largely exterminated along this section of the coast, but some mountain sheep and cariboo meat was secured from inland Eskimos, and large numbers of ptarmigan and fish were obtained in season. The health of all members of the party was excellent throughout the year, the only illness or casualty being that of Andre Noram, cook of the *Mary Sachs*, who became insane, with symptoms indicating paresis, and committed suicide by shooting, April 16, 1914, at Collinson point.

Although it was a disappointment to the members of the party to be held up by the ice before getting into Canadian territory, the time was improved by the men in becoming used to Arctic conditions—the methods of sledging with dogs, camping, and taking scientific observations at low temperatures. A large number of astronomical observations, solar and stellar, and a series of lunar occultations were taken at Collinson point, during the winter, for astronomical position and variation of compass and chronometer. An automatic tide-registering machine was kept in commission for a considerable time, meteorological records were kept up, and various collections were made. A snow-house makes a very good observatory, but at low temperatures great care must be exercised in handling delicate instruments, as the faintest breadth or even the insensible perspiration from a bare hand near the instrument will coat lenses and metal work with a film of frost crystals. Even guns are left out of doors all winter because if brought inside they become immediately coated with a thick mass of hoar-frost and ice, which takes a long time to melt, thoroughly wets the weapon inside and out as it melts, and rusts it badly if it is not taken entirely apart and thoroughly cleaned and oiled.

Desiring to begin work in Canadian territory as soon as possible, J. J. O'Neill started from Collinson point with a dog-driver and assistant in February, to begin geological work by a reconnaissance of Firth river (more generally known locally as Herschel island river), coming from the Endicott mountains near the international boundary and emptying into the Arctic ocean near Herschel island. This was carried out successfully, as well as a geological reconnaissance of Herschel island.[1]

K. G. Chipman and John R. Cox left Collinson point on March 16 and proceeded to Demarcation point. A series of solar observations for chronometer ratings were taken at the international boundary monument, the 141st meridian of west longitude. A stop was again made at the boundary when the party was sailing out, August 4, 1916, to get time sights again at the same place over twenty-eight months later. The coast line was surveyed to the eastward, tying in Herschel island with the surveys of the Alaska-Yukon International Boundary Survey of 1912. Mr. Cox then joined Mr. O'Neill in completing the topographical work on Firth river, and completed the coast survey by sled to Escape reef at the western edge of the Mackenzie river delta, where a gasolene launch was in readiness to work in the delta as soon as the river broke out.

Mr. Chipman and Mr. O'Neill later in the spring did some geological work in the Black Mountain district west of the Mackenzie delta until the river broke out about June 1. They then proceeded by whaleboat through the east branch of the Mackenzie, charting it as far as the south end of Richard island, after

[1] Summary Rep. Geol. Surv., Dept. of Mines, for 1914. Ottawa, 1915, pp. 112–115, 148–149. *Ibid.*, 1916, pp. 236–237.

which they proceeded to Arctic Red river and to fort McPherson near the mouth of Peel river, to pick up some consignments which came down by one of the Mackenzie river steamers. A launch which had been purchased for Mr. Chipman's survey party could not be made to run, and not as much territory was covered as expected, but with an expert sailor of the delta as guide, the utmost advantage was got from the whaleboat, and large portions of the middle and east branches were mapped, with a number of cut-off channels and smaller channels used in winter sled or summer whaleboat travel. At the same time Mr. Cox, with competent Eskimo guides, surveyed the west or Aklavik branch of the delta from Akpavachiak or Escape reef up to the mouth of Peel river. Astronomical positions were determined at Arctic Red river and fort McPherson and at several points in the delta, tying the work of the boundary survey with the work of previous explorers in the lower Mackenzie and Peel river country.[1]

There is a good 6-foot channel over the shoals around Tent island, near the mouth of the west branch of the Mackenzie delta, and passing these there is a deeper channel as far south as the outlet of Great Slave lake. Passing shoals of about five feet depth at that place, there is a deep channel again as far south as fort Smith, at the foot of the Grand rapids of the Slave river, 60° North latitude, near the northern boundary of Alberta. The channel into the east branch of the Mackenzie delta is also deep enough for fair-sized schooners, and the new Hudson's Bay Company's post at Kittigazuit on the east side of the delta southeast of Richard island is supplied from Herschel island by this route. The middle channel of the delta was not completely surveyed for lack of time, as the boat survey parties were obliged to meet the *Alaska* at Herschel island early in August to go east of the Mackenzie into the Coronation gulf region, where the main work of the Southern party was planned to be done.

Mr. D. Jenness, after coming ashore with Mr. V. Stefansson from the *Karluk* in September, 1913, had spent most of the winter in doing linguistic work among the Eskimos in the point Barrow region. Towards spring he came east to Collinson point and did ethnological and archaeological work from Collinson point to Demarcation point in the spring, later in the summer carrying on some extensive archaeological excavations at Barter island, Alaska, making large collections in the ruins at the site of the ancient trading rendezvous between the Mackenzie Eskimos and the western Alaskan Eskimos. Mr. F. Johansen made extensive collections of plants and insects, rearing many species of insects to study their life-histories and development. Some marine dredging was also done. During the fall and winter Chipman and Cox had prepared a map of the harbour at Collinson point and vicinity on the scale of $\frac{1}{24000}$, extending it inland to include some ten square miles of tundra, with 20-foot contours. The harbour was thoroughly sounded. It is not suitable for large vessels, carrying only about seven feet of water at the entrance, but is deeper inside of the lagoon. Vessels of somewhat larger size may obtain shelter by going behind some of the small islands in the chain extending west from Flaxman island. Further extended work along this section of the coast was not undertaken by the Canadian Arctic Expedition, for the reason that the well-known explorer and geologist, Mr. Ernest deKoven Leffingwell, who first came to Flaxman island on the Mikkelsen-Leffingwell Expedition in 1906, had spent most of his time from 1906 to 1914 with headquarters at Flaxman island, working on the geology of the Arctic coast of Alaska, and had prepared a very minute and accurate map of the coast, channels, and islands of the section from the Colville delta east, including a very complete series of soundings of all the channels. These charts and geological results are now in course of publication by the United States Geological

[1] Summary Rep. Geol. Survey, Dept. of Mines, for 1914. Ottawa, 1915, pp. 148-149.
Ibid., Report for 1915. Ottawa, 1916, pp. 237-239.

Survey, but the expedition was very much aided in 1913-14 by information received and tracings of unpublished charts kindly loaned to us by Mr. Leffingwell for our work on the Alaskan coast.

During the spring and summer of 1914, the routine and executive work of the southern party devolved upon me, including the apportionment of supplies and equipment for three vessels. The 10-ton gasolene schooner *North Star* had been purchased by Mr. Stefansson from its owner, Capt. M. Anderson, who was wintering in Clarence bay, a little east of Demarcation point. As a consequence, the time for zoological field work and the preparation of specimens was limited; nevertheless, 212 birds representing 52 species, and 77 mammals representing 13 species were collected and preserved. Nests and eggs of many of the species of breeding birds were also collected.[1]

The expedition vessels *Alaska* and *Mary Sachs* left Collinson point on July 25, 1914, the first day that the ice moved off the beach far enough to let us out of the harbour. The vessels had been free of the ice inside of the harbour since July 7. After some delays occasioned by ice, which was thick and close to the beach around Martin point, Icy reef, and Demarcation point, the *Alaska* reached Herschel island 69° 34′ N. Lat., 138° 54′ W. Long., August 5, and the *Mary Sachs* a few hours later. The *North Star* had got in from Clarence bay a little before. These expedition vessels were the first vessels to come into Canadian waters in the western Arctic flying the Canadian flag. The steam-whaler *Belvedere*, of Seattle, which had taken on a quantity of auxiliary supplies, coal, distillate, etc., from Nome in 1913 for the expedition, and had been compelled to winter in the ice a little off shore west of Icy reef, had come through safely and landed our stores at Herschel island about the last of July.

Herschel island is quite a busy place in July and August. Eskimo-owned and sailed boats, to the number of twenty-five or more, whaleboats, and perhaps a dozen two-masted Mackenzie-built schooners, were assembled here to trade with incoming ships. With the recent decline in the whaling industry in the western Arctic, and smaller probability of ships wintering at Herschel island, the Eskimos from the Mackenzie delta and from the westward had a still greater incentive to be at the island to trade during the short open season. In 1915, one year after the expedition went in, the Hudson's Bay Company started an innovation by spreading out on to the Arctic coast, and established a western Arctic district headquarters at Herschel island and another post 150 miles east of the Mackenzie river at cape Bathurst (Baillie islands), 70° 35′ N. Lat., 128° 05′ W. Long. Another post has been established at Kittigazuit (the point Encounter of Sir John Richardson) on the eastern edge of the Mackenzie delta, and the site of one of the largest villages of the Mackenzie Eskimos. In 1916, the Hudson's Bay Company moved 400 miles farther east along the coast and established another new post at the station just vacated by the Southern party of the Canadian Arctic Expedition at Bernard harbour, Dolphin and Union strait, 68° 47′ N. 114° 50′ W. These new posts of the company are supplied by a gasolene motor schooner, the *Fort McPherson*, from the large storehouses at Herschel island, stocked by chartered ships sent up from Vancouver, B.C. It is to be assumed that the commercial prospects of this region in the fur-trading line are of considerable importance. The presence of trading posts in hitherto untouched regions will facilitate the more detailed exploring and prospecting of districts which were formerly impossible except to specially equipped expeditions.

As previously reported,[2] Mr. Stefansson, after his separation from the *Karluk*, had established a base camp at Martin point, Alaska, with supplies

[1] Summary Report Geol. Survey, Dept. of Mines, for 1914. Ottawa, 1915, pp. 163–167.

[2] Report of the Dept. of the Naval Service for the fiscal year ending March 31, 1916. Ottawa, 1916, pp. 16–19, 71–75.

obtained from Collinson point, and from the *Belvedere* and *North Star* outfits, and started north from Martin point on March 22, 1914, on an ice-exploring expedition over Beaufort sea. The three men of the support party returned to land at Kamarkak, about 30 miles west of Herschel island on April 16, bringing the news that Mr. Stefansson and his two sailor companions, Storker Storkerson and Ole Andreasen, were going ahead fifteen days more travel before attempting to return, with the possibility of trying to push across the ice to Banks island in case conditions were favourable. As there were a much greater number of vessels and people than usual located at frequent intervals along the coast from Herschel island to point Barrow that season, the party would have been soon heard from if they had returned to the mainland in the spring or summer. As no further news was heard from the ice party, it was evident from knowledge of their plans that they had gone on towards Banks island.

The schooner *Mary Sachs*, under command of Mr. George H. Wilkins, with a full equipment of provisions, distillate, oil, etc., for two years or more, sledges, dogs, and a large gasolene launch, started from Herschel island for Banks island on August 11, and as we learned in the following spring, had met Mr. Stefansson's party near cape Kellett early in September, very soon after the vessel reached Banks island. Of course no word of this could reach the outside world until over a year later, causing considerable anxiety, as the three men of the ice party were generally supposed to have been lost for a year and a half. Having connected with the vessel with its supplies and exploring equipment, the activities of the Northern party during the remainder of 1914-15 were engaged in operations in the region of Banks island, Prince Patrick island, and Melville island. Advices received in the summer of 1916 indicated that the party was intending to remain in the north for at least another year. The *Mary Sachs* was still at cape Kellett, the *North Star* had joined the Northern party in 1915 and was hauled up on the northwest coast of Banks island, and the *Polar Bear*, a large schooner which was purchased in 1915, was wintering near the Princess Royal islands, in Prince of Wales strait, with the intention of moving on to Winter harbour, Melville island, for the winter of 1916-17.

While at Herschel island in August, 1914, we learned from SS. *Herman* of San Francisco, of Capt. Robert Bartlett's remarkable ice-journey from Wrangell island to Siberia, and his safe arrival at St. Michael's, Alaska, to bring relief for the shipwrecked *Karluk* survivors on Wrangell island, but it was not until November 9, 1915, that we got any more news from the outside world, and learned of the loss of eight members of the *Karluk* party on the ice, and the death of three more on Wrangell island, at the same time that we learned of the great European war, which had been going on for over fifteen months.

The schooners *Alaska* and *North Star* sailed east from Herschel island, August, 17, 1914, and were delayed a little by heavy ice in Mackenzie bay between Herschel island and Shingle point. Very little ice was found east of Shingle point, on the western edge of the Mackenzie delta, and we reached Baillie island August 21, finding that the *Mary Sachs* had gone on from there towards Banks island. Leaving Baillie island at noon of August 22, we anchored in Bernard harbour, Dolphin and Union strait, in the evening of August 24, and the *North Star* arrived on August 25. We had smooth sailing on summer seas east of Baillie island, free from ice except for a little loose bay-ice in Dolphin and Union strait.

At Baillie island we had met the little gasolene schooner *Teddy Bear*, going out under sail after spending five years in the Arctic. This vessel, which I had formerly met in Coronation gulf in 1911, was the first pioneer trading vessel to come in east of cape Parry. The *Teddy Bear* was commanded, engineered, and sailed by a young French-Canadian named Joseph F. Bernard, a native of Tignish, P.E.I., who had sailed from Nome in 1909 with one white companion to search for new fields for trapping and trading. His companion had been frozen

to death the first winter near Barter island, Alaska, and in 1910 Captain Bernard had gone on alone with a few Eskimos for crew and wintered a little east of the mouth of the Coppermine river. The next year he came out as far as the civilized Eskimo village at cape Bathurst, where he wintered. Without going home, he turned east again in 1912 and spent one winter in a harbour on the south side of Dolphin and Union strait, about sixteen miles south of Liston and Sutton islands, and a little west of Chantry island; the next winter in Lady Richardson bay, southwestern Victoria island, coming out in 1914 after voyaging for five years. His harbour in Dolphin and Union strait, being the first good harbour for nearly 200 miles east of Pierce point, was used as a base station for two years, 1914-16, by the Southern party of the Canadian Arctic Expedition and named by us Bernard harbour, partly in honour of Captain Bernard's pioneer energy in discovering its suitability and using it as a ship station and in recognition of his unusual kindness and rectitude as a pioneer of trade in an uncivilized and unexploited land.

Bernard harbour was chosen by us for its strategic advantages for working the coast both to the west (from cape Parry) and to the east (into Coronation gulf), as well as its nearness to Victoria island (about 35 miles north across the strait). It was about as far east as driftwood could be found in reasonable amounts for fuel.

After discharging the cargoes of the *Alaska* and the *North Star*, and replacing a broken propeller on the *Alaska*, I finally started west with *Alaska* again on September 6, with the intention of getting some driftwood timber from farther west, as well as some more coal from our cache at Baillie island. The members of the scientific staff, with Mr. Chipman in charge, were left at Bernard harbour, to put up winter quarters, with some Eskimo assistants. Capt. D. Sweeney, Mr. D. W. Blue, engineer, Mr. A. Castel, J. Sullivan, cook; Mike, the Eskimo assistant engineer, and Ikey Bolt, a point Hope Eskimo sailor, went west with me on the *Alaska*. Finding weather conditions very favourable at Baillie island, and no ice reported to the westward, it seemed well to go on to Herschel island, to bring on additional coal and oil, and additional supplies which had been expected to arrive from the westward during the summer. The *Alaska* reached Herschel island again September 11. The *Ruby*, which was expected with supplies from the west, had not arrived, and after loading some stores from our reserve stock at Herschel island, on the *Alaska*, we started east again on the morning of September 13.

The *Alaska* came back to Baillie island on the night of September 15, in the midst of a northwest gale, with frequent snow-squalls, and spray freezing on the decks and rigging. The storm kept rising for the next two days, the worst storm of the season, and did not abate until noon of September 19. There was a very high storm tide, rising about 4 or 5 feet at Baillie island, the waters of Liverpool bay seeming to have been piled up by the northwest gale and forced out between the Baillie islands and the mainland. The distillate drums and coal sacks which had been landed on the beach in the summer were half buried by the sand washed up, and we had to dig them out. Quantities of large ice had come in from the northwest during the big storm, but we tried to go out on the morning of September 20.

In trying to turn around in our narrow anchorage, the bow of the *Alaska* ran slightly in the mud. We tried to kedge her off, but with the falling of the westerly wind, the storm tide fell rapidly, and we were soon settled hard aground. The whole cargo had to be discharged and the schooner finally floated free again on the evening of September 24. As the nights were getting very dark at this season of the year with the moon gone, and considerable heavy ice was coming in from the northward, with young ice forming thick and slushy at times, it was a precarious matter to sail at night with a small vessel. In the summer time, with daylight all night, a vessel can tie up to the ice, but it is a different matter

in the autumn when the ice is moving in the dark. From the outlook at Baillie island, with at least three days more delay loading ship from the beach in a dory, it seemed doubtful that we could get east of cape Parry, or possibly Pierce point, and there are no harbours beyond that nearer than Bernard harbour. As we did not have much to bring back to Bernard harbour, and nothing that was absolutely necessary, the advantage in getting back there with the *Alaska* did not seem commensurate with the risk involved to the vessel, so I decided to put the boat into winter quarters at Baillie island, or rather into the harbour behind the end of the Cape Bathurst sandspit. The *Alaska* had to go to Herschel island the next summer (1915) anyhow for supplies and mail, and had a better chance of getting out early from Baillie island than from farther east. The scientific staff, with their supplies and equipment, and the *North Star* were already favourably located at their desired base, and I knew that I could join them by sledge as soon as ice travelling was good. There was a fair amount of supplies on the *Alaska* for the men who were to remain as ship-keepers during the winter. Two fresh whale carcasses on the beach near the ship provided an abundance of dog-food and also attracted a number of polar bears and multitudes of white foxes to the vicinity. Fifteen polar bears were killed by the men on the *Alaska* before I started east on November 20, the skins kept for specimens and the meat frozen and stored away. A number of seals and ducks were killed in the autumn, and seals were killed frequently during the winter.

On November 20, 1914, I started to go from the *Alaska* at cape Bathurst to the winter base of the Southern party on Dolphin and Union strait, an approximate distance of about 400 miles, accompanied by Aarnout Castel (sailing master of the *North Star*), James Sullivan (cook of the *Alaska*), and the Eskimo, Ikey Bolt taking one Nome sled and seven dogs. We followed the west side of Franklin bay 90 miles to Langton bay. The only inhabitants on the shores of Franklin bay that winter were two families of Mackenzie Eskimos who had taken a small schooner belonging to the Hudson's Bay Company from the Mackenzie river, to the mouth of Horton river, where they were wintering. This vessel went back to the Mackenzie, the following summer. The sailing schooner *Rosie H.*, which has been permanently in the Arctic for many years, was wintering at Booth island (cape Parry) with one white man and several Herschel island people. We did not go around cape Parry, but shortened our distance considerably by crossing the portage at the south end of the Parry peninsula, from Langton bay to Darnley bay. The yawl *Argo* came in from northern Alaska with two white trappers and their families, to the southwest corner of Darnley bay in 1913 and remained until 1915. On the southeast side of Darnley bay we passed the house of Capt. Christian Klengenberg, an ex-whaler with his family, and another house belonging to an Eskimo family which had come in from Alaska on the *Argo*. Klengenberg's young son and daughter had a temporary trapping camp a little east of cape Lyon, and east of that there were no inhabitants west of Dolphin and Union strait. East of Baillie island there are no permanent residents, and the western Eskimos make only casual excursions into the territory.

The *North Star* had made a cache of provisions and coal oil at Pierce point in the fall, and we took some supplies from it on this trip. We did not know whether we should find driftwood enough for fuel at all points along the coast on the 200 miles between Pierce point and Bernard harbour, and expected to use a "Primus" coal oil stove part of the time. However, we found enough driftwood, for fuel at every camp site along the coast, and put up piles of wood at various points so that there would be no danger of having the wood covered with heavy ice before we should pass along the coast in the spring. On December 10, behind Keat's point, we met Kenneth G. Chipman and John J. O'Neill with a sled. They had left Bernard harbour November 19, to make a preliminary topographical and geological reconnaissance as far west as Pierce point, in preparation for the coming spring's work, as well as to look for the whereabouts of the

Alaska. They had found the weather very unfavourable for survey work, being foggy earlier in the season, and storms and blizzards prevailing later. They had been held in camp for six days straight when we met them, with strong head wind and blizzard, while we had been able to travel part of the time with fair wind, which makes a tremendous difference. They turned around and accompanied us to the eastward. We found open water pretty close to the shore all along from cape Lyon to Clifton point, and at Deas Thompson point the ice had recently broken away from the cliffs and we had to make a detour around over the hills. We were delayed two days by a blizzard near Wise point, and reached the winter quarters of the main party about noon, December 25. Travel had been rather slow, principally on account of the shortness of the days at that time of the year, between 69° and 70° North. It was barely light enough to see a trail at 9 a.m., and it was dark about 3 p.m. on clear days, while the period of daylight was considerably shorter on cloudy and foggy days. The temperature in general was warmer than usual at that season, not going below zero Fahrenheit at any time of observation during the first two weeks of December, 1914, and an occasion rising to 25° above zero Fahrenheit. Before leaving Baillie island we had a cold snap, the thermometer reaching 31° below zero on November 7. Coming east from cape Lyon the prevailing wind was favourable, from the northwest. The freeze-up in 1914 occurred at cape Bathurst about September 30, and at Bernard harbour about October 16.

Everything was in good shape at Bernard harbour, the winter quarters of the most of the Southern party. A frame house had been built, covered partially with boards and partially with canvas, and the whole sodded over in the autumn. Enough small driftwood had been picked up in autumn to last for fuel until Christmas, and more was hauled later in the winter, and pieced out by a sparing use of coal. East of cape Bexley there is very little large driftwood on the beaches, on the points around Cockburn point, east of cape Bexley, there is quite a quantity of small pieces of wood, and quite a bit on Chantry island, but very little east of Chantry island of any kind.

About thirty seals had been killed at Bernard harbour in the autumn, by shooting at the edge of the ice in the western method, but only four caribou were killed. The great herds of caribou which usually cross the strait near this point from Victoria island to the mainland, did not pass near Bernard harbour in 1914. The Victoria island Eskimos who visited the station later, said that the reason the caribou did not cross here this autumn was on account of the late freezing of Dolphin and Union strait. The caribou came down in large numbers to the south coast of Victoria island north of here, and as the strait was not frozen so that they could cross over, they moved eastward along the south coast of Victoria island and crossed some distance to the eastward. The Eskimos on the Victoria island side north and east of Bernard harbour killed large numbers of the caribou in the autumn, and we were able to purchase all the frozen caribou meat we needed as soon as the Eskimos could haul it across, and later, after the Eskimos' winter sealing, by spearing through the ice, had commenced, we were able to buy all the fresh seal meat we needed for dog-food or table use.

During February and March, 1915, Mr. Aarnout Castel and myself made a toboggan trip from Bernard harbour across the west end of Coronation gulf, up the Coppermine river, to Dismal lake, and across to the Dease river, northeast of Great Bear lake. We were much delayed by soft snow amongst rough, jagged ice on the Coppermine, and our dogs were too exhausted to be able to proceed very far through the very deep, soft snow on Dease river, so we had to turn back to the coast without making connections with any white man or Indians on Great Bear lake to take out our winter's mail. We reached Bernard harbour again April 1, and a little later the mail was sent out along the coast to the *Alaska* at Baillie island.

On the Coppermine river, around Dismal lake, on the Horton river (south of Franklin bay), and to a less extent farther west, we have often noted the large proportion of dead spruce trees near the northern limit of timber. In some areas about 90 per cent of the trees are dead, in districts which show little or no evidence of forest fires. Mr. F. Johansen and Mr. D. Jenness accompanied our inland trip as far as the edge of the timber-line on the Coppermine, near the Sandstone rapid. Mr. Johansen made a careful study of forest conditions here and found that practically all the dead trees which were examined showed traces of the ravages of bark-beetles, three species of them being found. This knowledge may be of value to northern forestry.

The programme for the spring's work had been planned before going inland. Mr. John R. Cox, with an assistant, started in March and made a careful survey of the coast along the south side of Dolphin and Union strait from Chantry island east to cape Krusenstern and as far south as Lockyer point. Starting again in April, he carried the survey around the west end of Coronation gulf, including Basil Hall bay and the north side of Back inlet, as far as the mouth of Rae river. Rae river was ascended and carefully surveyed for about 70 miles, until it forked into two small creeks. Large willows were found at rather frequent intervals on Rae river after getting some way from the coast, but no spruce or other timber. After reaching the head of Rae river, Mr. Cox's party made a six-day portage across country with their sled, striking the Arctic coast on the south side of Stapylton bay. Numbers of caribou were seen migrating steadily northward during their work on the Rae river and the trip to the coast, and they had no difficulty in killing a caribou whenever they needed meat. Mr. Cox then surveyed the section of the coast from Young point (the western end of Stapylton bay) east to the home station, reaching Bernard harbour May 25. He found that South bay, southwest of cape Bexley, was somewhat deeper in extent than we had supposed, and that Stapylton bay is not as deep as the existing charts make it appear. The rock exposures on Rae river were the prevailing dolomite and limestone of the region, with diabase near the mouth of the river. At cape Kendall, a little north of the mouth of the river, high diabase cliffs are found overlying sandy limestones.

Mr. Kenneth G. Chipman and Dr. John J. O'Neill started on the western survey from Bernard harbour on March 17, 1915, going direct to the west end of Darnley bay and working east. Connecting with the previous surveys of the Parry peninsula, the survey was carried east during April, the season being much further advanced than it was farther east during the same period. As there are no rock exposures near the coast near the south side of Darnley bay, Dr. O'Neill was able to remain on the east side of the bay to carry on geological investigations in more detail, while Mr. Chipman completed the topographic work on the southwest part of the bay.

The southern part of Darnley bay had never been surveyed before and only imperfectly explored. Two fairly large rivers flow into the south and southeast sides of the bay, the most southern of which seems to have been visited by Mr. A. J. Stone[1] while on a short trip after muskoxen from the whaling ships which were wintering in Langton bay in 1898, and indicated by him on a rather inaccurate sketch-map as Hornaday river. As the river is approximately identifiable, and has no discoverable local name, it seems proper that the name Hornaday river should be retained for this river, in honour of the well-known advocate of Wild Life Conservation in the United States and Canada. For the southeastern river we propose the name Brock river, in honour of the patriotic and capable geologist, Major R. W. Brock, former Director of the Geological Survey, to whose active interest in Northern geology the organization of the geological and topographical sections of the expedition are largely due. Dr.

[1] Stone, A. J. Some Results of a Natural History Journey to Northern B.C., Alaska, and N.W.T. Bull. Amer. Mus. Nat. Hist., Vol. XIII, vi, New York, 1900, pp. 63–67.

O'Neill ascended this river for some distance, and made a good geological section of the country. Inland on the east side of Darnley bay he found beach gravels and terraces above 500 feet, and everywhere east of that point the country for some distance from the coast is of the same type. From Darnley bay to the east of Deas Thompson point there are a number of high points which have received the name of mountains, but no definite system of range is apparent. The highest of these points (Mount Davy) is between the Croker and Inman rivers. The coast has a well-defined shore-line of rock or boulders and gravel.[1] None of the rivers flowing to the coast east of Darnley bay extend any great distance inland, for their valleys are small, and both valleys and beds indicate a very heavy run-off in a short time. The Croker is the largest river, with its delta built out a short distance, and occupies a triangular valley some 4 miles wide at the coast, and extending inland for 3 or 4 miles. The river spreads out over its delta, and none of its channels are very definite. The beds of this and other rivers are composed of heavy boulders, and the quick run-off is further indicated by the continuous sandbars built across their mouths when the river is low in summer and fall.[2]

The coast-line as traversed from cape Lyon eastward was found to be somewhat more straight than the former charts give it, but this is apparently due to the practical impossibility of sketching a coast-line accurately on a hurried boat-passage some distance off-shore, with infrequent landings. This method has given the result that many of the so-called points on this coast are not salient projections of the coast line. More often the charted points and capes are high land or rock cliffs with low land on either side. This gives the higher places the appearance of points or capes when viewed from a distance. Our method of locating control points at frequent intervals by latitude, longitude, and azimuth observations, traversing between these points by frequent compass sights and pacing all the intervening shore-line, will undoubtedly give a more accurate map, although the former maps of this section of the coast are really very good considering the conditions under which they were made. No serious rectification was necessary until we came to Stapylton bay and eastward of that point. Mr. Chipman regards the whole country surveyed as evidently a portion of the coastal plain described by Tyrrell,[3] which west of Hudson bay reaches an elevation of 500 to 600 feet, and varies in width from 75 to 300 miles. Numerous fossil shells are found along the old beach terraces. West of Chantry island fossils were collected from the 15-foot and 30-foot horizons. These fossils may be duplicated on the present strand-line. Near the mouth of Inman river, fossil shells were found in numbers up to 170 feet above sea-level.

Dr. O'Neill reports the country rock,[4] at least as far west as Clifton point, as a light grey to buff-coloured dolomite, sometimes with interbedded grey chert, and frequently containing fragments and nodules of the same. Ripple-marking and what seems to be mud-cracks were seen in some layers. A concretionary structure is quite common. The beds vary in thickness from a fraction of an inch to a few feet, and in grain from very fine to quite coarse and crystalline. They have a dip of about 10 degrees, a few degrees north of west. About 15 miles east of De Witt Clinton point there is a cliff of conglomerate 40 feet in height with an 8-foot capping of sandstone. The conglomerate is made up almost entirely of pebbles of quartzite and chert, and has a few small seams of buff-coloured sandstone interbedded with it. The overlying sandstone is coarse-

[1] Chipman, K.G. Summary Report of Geol. Survey, Dept. of Mines, for the year 1915. Ottawa, 1916, p. 245.

[2] Summary Report of the Geol. Survey, Dept. of Mines, for the calendar year 1915. Ottawa, 1916, p. 245.

[3] Tyrrell, J. B. Report of the Doobaunt, Kazan and Ferguson rivers, vol. 9, p. 158.

[4] Summary Report of the Geol. Survey, Dept. of Mines, for the calendar year 1915. Ottawa, 1916, pp. 239–241.

grained and weathers reddish-brown. About DeWitt Clinton point there are cliffs of very dark grey limestone 40 to 50 feet high, with beds 3 or 4 feet thick, and with a few thin beds of light grey limestone. At one place fine-grained diabase cuts through the limestone and spreads out as a capping on the cliff. The hills about here are covered with a mantle of alluvium, resembling glacial morainic material, which weathers to a buff colour on the surface. It is at least 30 feet in thickness. About Deas Thompson point there are cliffs of limestone 30 feet in height, dark-coloured at the base and lighter grey above, thin-bedded, and with encrustations of gypsum along seams and in fissures. Keats point is made up of coarse, reddish-coloured sandy dolomite. There are two distinct sets of glacial striae in the vicinity of Chantry island, one set running east and west (true), and the younger set running north 77 degrees east (true).

In an examination of the rocks from the foot of Darnley bay to cape Krusenstern, no evidence of the existence of copper was seen. A series of sediments is intruded by sills, or sheets of diabase at intervals from 20 miles south of cape Lyon to DeWitt Clinton point; no diabase is then seen again until one nears cape Kendall on the west side of Coronation gulf; north of Back inlet.

After returning from the inland trip up the Coppermine, I started west from Bernard harbour April 21 to reinforce the western survey party, meeting Chipman and O'Neill coming east near Deas Thompson point on Amundsen gulf. The Eskimos, Ikey and Palaiyak, who were with the party, were sent on to Baillie island with the mail, and to help on the *Alaska*, while I returned eastward again with the survey party. Owing to the extremely short-handed condition in which the Southern party was situated and the large amount of work planned for the coming summer, it was impracticable for me to return to Baillie island and return to Herschel island again with the *Alaska*, as I had intended. Instructions were forwarded to Capt. Daniel Sweeney of the *Alaska* at Baillie island, and he carried out the summer's work of the vessel very creditably and carefully, bringing in the mail, and a good load of additional provisions and coal from Herschel island. The ice left the beach at Baillie island, at 5 a.m., July 10, 1915, according to Captain Sweeney's report, and the *Alaska* got out of the harbour at 9 p.m., reaching Herschel island July 13. The first vessel to reach Herschel island from the outside was the *Polar Bear*, which arrived August 3; the *Ruby*, which brought in stores for the Canadian Arctic Expedition arrived August 14. The *Alaska* was loaded and left Herschel island to go east again August 22, reached Baillie island in the evening of August 23, left Baillie island in company with the missionary boat *Atkoon* of Collingwood, and the schooner *El Sueno*, arriving at Bernard harbour September 5, 1915. The *El Sueno* arrived September 7, bringing in a small amount of auxiliary supplies for the Southern party, and at once went west again to winter at Pierce point, for the purpose of trapping. The *Atkoon* was blown up on the shore between Clifton Point and the mouth of Croker river, but the vessel was apparently uninjured, and the missionaries established a winter camp there.

Our western survey party reached the station at Bernard harbour on May 24, 1915, one week ahead of our scheduled time. We had decided upon the date June 1 as the time for the sledge-survey parties to be back at the station, to avoid being troubled by the breaking out of the rivers. The unusually mild weather during the month of May facilitated our work very much. The skies were usually clear, and conditions good for travelling and taking observations. The weather was very warm and the snow thawing fast around Croker river May 16, but east of that point the season was more backward, and at Bernard harbour the ground was completely snow-covered until after the first of June. The snowfall is not very deep in this region, however, and after the snow really starts melting, it practically disappears from the land within a very few days, except the remains of deep snowdrifts in gullies and on the shady side of hills.

From the experience of the topographers of the Southern party of the expedition this spring, and in the year preceding and the year following, it was found that very little accurate topographical surveying on the lines laid down for us, 10 miles to the inch, with control stations at frequent intervals, could be done before the middle of March at the latitude we were working (from 67° 30′ to 70° approximately). Some compass lines could be run before that time, where salient points were already located, but earlier than the middle of March the sun is too near the horizon to get satisfactory observations, on account of the great refraction near the horizon. Blizzards and clouded skies were so frequent early in the spring that calculated occulations of stars and planetary satellites could only rarely be observed at a stationary observatory, and such observations were of little use in field work, and by the latter part of March the daylight period was so nearly continuous that there was no opportunity for other than solar observations after that season.

On May 21, 1915, Mr. George H. Wilkins arrived at Bernard harbour, accompanied by James R. Crawford, discharged as engineer of the Northern party's schooner *Mary Sachs*, and one Eskimo, named Billy Natkusiak. They had come from the winter quarters of the *Mary Sachs* near cape Kellett, Banks island, making the trip in about twenty-five days, across the southern end of Banks island, Prince of Wales strait, Prince Albert sound, and Dolphin and Union strait. Mr. Wilkins had found the Stefansson party safe near cape Kellett the summer before, and had come to make some arrangements to take the *North Star* to Banks island or Prince Patrick island as an auxiliary for further advanced party for proposed more extended work of the Northern party. The plans for the work of the Southern party had been based on the certainty of having the *North Star* for the summer's work in Coronation gulf, as the *Alaska* was at Baillie island, and bound to go to Herschel island before coming in again. It was finally arranged that the *North Star* should first lay down some provision depots in Coronation gulf and take the gasolene launch and outfit as far east as cape Barrow, and then go west to Herschel island, and later to Banks island.

Mr. Wilkins had lost his cinematograph outfit on the *Karluk*, but had obtained another cinematograph camera and a few thousand feet of film from the engineer of the wrecked schooner *Elvira* in 1914. He made a short trip on the ice of Coronation gulf and secured studies of Eskimo life in camps on the ice, and later in the season, views of their summer camps, fishing scenes, and home life and habits. About 2,000 feet of cinematograph film was exposed, most of which was ultimately developed and found to be of good quality. Mr. Wilkins made a very good series of portrait studies of most of the local Eskimos (Dolphin and Union strait), men, women, and children, in full view and in profile, for Mr. Jenness's ethnological work. He also made good photographs of growing plants, insects, etc., for the botanist and entomologist, and many photographs of birds, mammals, etc., in their natural habitat; pictures of great scientific as well as artistic value.

The expedition had always prided itself on being thoroughly prepared and equipped to take the field and work at any season and under any conditions. These problems of equipment may be roughly covered under four heads: (*a*) Winter and early spring sledging with tent or snow-house, using either wood, alcohol, Primus coal-oil stove, or native blubber-lamp; (*b*) late spring and early summer, prepared for either land or water travel; (*c*) summer travel with boat or canoe; and (*d*) overland packing by men and dogs in summer..

The western survey parties having finished their work late in May, it became necessary to start early summer work at once to the eastward. In Coronation gulf the ice was still solid in June, but there was the possibility of cracks and leads to cross as the season advanced, and boat-work after the break-up of the ice. The Northern party of the expedition had made good use of waterproof tarpaulins in constructing sled-rafts to cross leads, being

unable to haul canoes over rough ice, but of course this made no provision for travel after the break-up of the ice. Our problems were somewhat different, as in Coronation gulf the ice was comparatively smooth. We took a large point Barrow whaling umiak, about 28.15 feet in length, and 6 feet beam, covered with heavy bearded-seal skins, and strengthened the stern timbers to provide for the adjustment of an Evinrude detachable gasolene motor, which proved to be a very valuable auxiliary. The canoe could be lifted by two men and placed on a low, ivory-shod boat-sled, which could be hauled in the spring by four or five dogs, carrying several hundred pounds of baggage inside of the boat. If necessary to cross a lead, the umiak could be unshipped and launched in a few minutes, and if the ice should break, the canoe would be launched automatically, already loaded. Later in the season, the umiak proved its worth by carrying two or three men, three dogs, and a thousand pounds or more of provisions, gasolene, and camp gear, making 5 to 6 miles per hour, and weathering some pretty heavy seas. It could be beached on any kind of coast in a hurry, by rolling it up on inflated sealskin " pokes," a great advantage when exploring a coast whose harbours are unknown, and a sudden breeze speedily raises a dangerous lop, as it does in Coronation gulf. The umiak is also a very useful boat among ice-floes, as it is practically unstovable and can be easily and quickly hauled upon or over an ice-cake, and it will also stand bumping over the boulders on a river-bottom which might prove disastrous to a wooden boat. The weight of a wooden boat of sufficient size would also be an insuperable obstacle to transportation by sled. For inland work in the Coronation gulf region, recourse must be had to packing in the summer, as most of the streams are too small and rapid to be navigable for any distance. The survey parties were supplied with condensed rations, and had dog pack-saddles for their largest and strongest dogs. Three or four good dogs can pack all the necessary provisions for a small party for several days.

On June 9, 1915, John R. Cox, topographer, and J. J. O'Neill, geologist, started eastward from Bernard harbour with the umiak on a boat-sled, taking also another large sled-load of provisions, supplies, and gasolene. They had as assistant for the early summer an intelligent Alaskan Eskimo, Billy Natkusiak, who had been with me in the region several years before, and also as an experiment, a family of Coppermine Eskimos (a man named Mupfa, with a wife and child). We had heretofore little success in getting any useful service from the local aborigines, who have little or no idea of serving or working for anyone. It seemed necessary, however, to engage somebody to look after the sledge dogs, or part of them, after the surveying party should have to take to boat work, and this native engaged to help in the spring and look after our dogs during the summer at a fishing-place on one of the rivers on the south side of Coronation gulf. The man Mupfa turned out to be a very capable, intelligent man, and willing to learn, and carried out his agreement for the summer very creditably, and rendered loyal service to the expedition for the remainder of the next year. The party was to proceed by sled to Tree river, or the Annielik (in Gray's bay); during the early summer to work geologically up some of the rivers in that region, moving gradually along the coast to cape Barrow, 68° 01′ N., 110° 09′ W., the western extremity of Bathurst inlet, where Mr. Chipman and I would meet them with the *North Star* about the first of August, if possible, bringing the gasolene launch and additional supplies.

At cape Barrow, the circumstances of the season and the condition in which we found the party and the boats at that time, would determine the extent of the survey which we could make of Bathurst inlet during the latter part of the summer. It was planned to finish up as much as possible of the eastern end of our assigned territory during the summer of 1915, leaving the region nearer home (around the mouth of the Coppermine river) for the early autumn or coming spring, when the unfinished ends could be worked to better advantage

from the base station. During the early summer of 1915, Mr. K. G. Chipman began a stadimeter survey of the region about Bernard harbour, with 20-foot contours. Mr. F. Johansen did some dredging for marine life in the inner and outer harbours, and completed his collections of the plants and insects of the region, while my own collections of birds and mammals was considerably increased. Considerable quantities of salmon trout were sun dried for winter dog-food, and some caribou meat was also dried for our own consumption. The few families of Eskimos who remained about during the early summer caught and dried large numbers of lake trout, catching them with hooks through the ice in June and early in July, and spearing and gaffing large numbers of salmon trout which were impounded in stone weirs when they started to run up the streams in July. By the last of July all the local Eskimos had departed on their summer packing expeditions to look for caribou inland.

The summer of 1915 was very late and cold, and the ice melted very slowly. The *North Star* had started to leak badly during the winter, and we finally succeeded in getting the vessel free from the ice and hauled up on top of the ice in the harbour July 7, and caulked her thoroughly. A few days later the ice had melted enough to drop the vessel into the water again, and on July 20 all the ice was out of the harbour. Bay ice disappears with wonderful rapidity at that season, the hot sunshine cutting away the top almost visibly, the ice floating up as it melts, and when it finally disintegrates into small pieces which touch the water on all sides, soon disappears absolutely. After the harbour and the large bay south of Chantry island were free of ice, Dolphin and Union strait was pretty full of ice. Broad leads opened up outside for a little, but the ice seemed pretty solid to the eastward. A steady, strong northwest wind for a week, practically a gale for three or four days, kept driving the ice down into and blocking up Dolphin and Union strait, and in the early part of August, between Bernard harbour and the Liston and Sutton islands, the strait was packed full of rough, heaped-up blocks of ice, where we had only smooth bay ice all the previous winter.

After being held for nearly two weeks after the break-up of the ice by heavy ice packed into Dolphin and Union strait by continued westerly winds, a spell of easterly wind started the ice moving westward again, and we worked the *North Star* out through the ice east of Chantry island August 9, finding the ice slowly moving westward. We were unable to get by the south side of Lambert island after going about half-way, finding the south side of the strait pretty well packed with ice, and went back around the west end of Lambert island to the north side of the island, passing over some dangerous rocky shoals extending for some distance off the west end of Lambert island, 6 feet of water 400 to 500 yards off shore. There is also a series of rocky islands and reefs off the east end of Lambert island. We passed cape Krusenstern in the evening of August 10, and passed through the Duke of York archipelago during the night, finding very little ice after passing cape Krusenstern, and Coronation gulf entirely free of ice to the eastward. We reached port Epworth, the splendid harbour at the mouth of Tree river, 67° 46′ N., 111° 59′ W., and found a large stone beacon on the island at the mouth of the harbour, with a cache and a note signed by J. J. O'Neill and J. R. Cox stating that they had been working in that region until July 30, when the ice moved off the coast allowing them to proceed eastward. They had gone on east to cape Barrow, where we found another beacon on August 12, stating that they had reached that point August 2. They had been delayed by head winds, and we soon found the party camped in a little bay just east of cape Barrow. The *North Star* put down a large cache of provisions at port Epworth, consisting of flour, rice, pemmican, sugar, and gasolene for the two motor-boats; and another cache at cape Barrow for use during the summer of 1915 and the possibility of sledge work in the spring of 1916. The *North Star* at once started back to the westward, on August 12,

having been delayed only three days after getting out of the harbour in making the eastern trip. Having a stiff fair breeze behind her, the *North Star* was back at Bernard harbour within twenty-four hours, and finding all the ice had moved to the westward, kept on going and soon reached Baillie island. The party who went west on the *North Star* consisted of George H. Wilkins, commanding; A. Castel; James R. Crawford (discharged at Baillie island to go out on schooner *Ruby*); and the Eskimo, Billy Natkusiak. The party remaining at cape Barrow consisted of four men, K. G. Chipman, J. R. Cox, J. J. O'Neill, and myself, with one 20-foot wooden gasolene launch with 7-horsepower Gray motor, and the skin-umiak with Evinrude motor.

Cox and O'Neill, with their Eskimo assistants, had left Barnard harbour June 9, hauling the skin umiak on a boat sled, and crossed Coronation gulf direct from cape Krusenstern to the mouth of the Tree river (port Epworth), being delayed by only one large crack in the ice, about 30 feet wide. The season was much further advanced around Tree river than it was at Bernard harbour and the ice was soon cut away around the mouth of the river. Large quantities of fish were caught after the opening of the bay, and in addition to what were used by the party and their large bunch of dogs, over 500 pounds of fish were dried, baled and put *en cache* on the island at the mouth of the harbour for autumn use. Wolverines are surprisingly abundant on the coast in this region, and unless provisions and stores are cached on islands they are apt to suffer from the ravages of these brutes during the summer. Tree river was explored for some distance inland on a packing expedition in July. Like all the other streams in this region (in the granite area) it has rapids, cascades, and falls a few miles from its mouth. It abounds in fish in the summer-time, and several families of Eskimos usually spend the summer at the first cascade, catching fish by spear, hook, and raking with a sort of double gaff-hook. Salmon trout and two species of white-fish are largely caught in the rivers, while large lake trout are caught in nearly every lake of any size. The country a little back from the mouth of Tree river is dotted with innumerable clear lakes, basins in the granite, and the vegetation, particularly in the flowering plants, is richer than the average condition in the Arctic. A good collection of plants was made here during the early summer. Tree river has two large branches, one of which is said to rise near the east bank of the Coppermine. This western branch of Tree river is said to have spruce trees near its source. The scenery around port Epworth is quite striking, vertical cliffs of dark-coloured diabase, with long talus slopes, rising to a height of 600 feet above sea-level on either side of the harbour. A long ridge of dolomite runs west from the mouth of the river, about five miles back from the island at the entrance of the harbour of port Epworth. The island at the entrance of the harbour is black shale at the base, overlain with diabase. About five miles south of the mouth of Tree river a ridge of rounded granite mountains runs to the south and east side of the river, the highest peak noticeable, about ten miles back from the entrance of the harbour, being 1,090 feet above sea-level. It is interesting to note that about half a mile east of the mouth of Tree river, there are small crevices or pockets in the granite which are filled with the soft potstone (a talc chlorite schist), much used by the Eskimos of this region for making the stone blubber-lamps which are universally used by them, and also for making stone cooking pots. The use of the cumbersome, heavy, and fragile stone pots, however, is very rapidly declining, owing to the much greater convenience of tin, iron, and copper-ware which are being introduced in trade. There is no known potstone quarry west of Tree river, and most of the stone utensils come from there although the Eskimos informed us that there are also some smaller stone deposits on the Utkusikaluk, flowing into Gray bay, and somewhere around cape Barrow.

According to Dr. O'Neill,[1] the islands in Coronation gulf, on a line southeast from cape Krusenstern to port Epworth, are all of diabase; no amygdaloid was seen, but some of the islands are cut by narrow veins of calcite which contain small patches of chalcocite. While making a second trip through these islands in May, 1916, I was impressed by the rugged formation of these islands, including many of the islands of the Duke of York archipelago. The group known to the Eskimos as Pauneyaktok, about 20 miles southeast from cape Krusenstern, are typical of the group, having precipitous cliffs of diabase running up to 200 feet in height, facing to the south and southeast, and sloping down to the water's edge on the north and northwest sides. Underneath the diabase of one of these islands, I noticed an exposure of sedimentary rock, a series of alternate layers of black and reddish strata about one inch thick, merging into a tick, flesh-coloured stratum. The base of the islands is very seldom visible, being hidden by talus slopes from 10 to 40 feet high.

" The coast from port Epworth to Grey's bay is diabase cutting grey shale or red sandstone, which immediately underlies the shale; no amygdaloid nor copper is in evidence in this diabase, of which the upper part has been removed by erosion. The Laurentian granite comes to within 3 miles of the coast at the Kŏgluktualuk or Tree river, and its western contact with younger sediments extends almost true south for over 30 miles. The northern border of this granite parallels the coast to the west end of Gray's bay; it forms the southern shore of Gray's bay and the whole coast from that place to the east side of cape Barrow."—(O'Neill.)

Cape Barrow, 68° 01′ N., 110° 09′ W., or Han-in-nek, as it is called by the Eskimos, is a mountainous granitic region, but is not nearly so high as stated by Franklin in 1821[2]. He says: " The higher parts attain an elevation of 1,400 and 1,500 feet and the whole is entirely destitute of vegetation."

In 1915 we found the height of the highest of the granite ridges to be 340 feet above the sea-level, by aneroid, and although the hills have a barren appearance on their summits and slopes, careful inspection shows many bright green patches in little valleys and gullies where soil has collected, as well as in basins in the rocks, around the little lakes—green grass, low dwarf willow, deep tundra moss, cotton-grass or " nigger-head " tussocks (the *têtes des femmes* of the northern Indians and voyageurs) heather growing luxuriantly in many shelving rocks, and about ten species of flowering plants in bloom close to our camp on August 13. The summits of the granite ridges were usually covered with gray lichens. In this region we were often deceived by great reddish areas on cliffs, giving the appearance of a ferruginous rock, but upon closer examination proving to be only a dense coat of red lichens.

After the return of the *North Star* to the westward, Chipman, Cox, O'Neill, and myself continued the survey east from cape Barrow with the small launch, umiak, and a Peterborough canoe. It turned out that this plan cut down to some extent as originally planned, as we had to lie over a good many days on account of stormy weather and high winds when we could not use the small boats, and might have gone ahead or anchored in more favourable place with the *North Star*. With the small boats we had to find a very small and very well-protected harbour for each night's camp. We were also prevented from getting back to the station before the freeze-up, as the almost continuous heavy weather late in the autumn prevented us from travelling a large part of the time with the small boats. The Evinrude motor did good service in the early part of the season on the umiak, and the two boats were able to work to some extent independently, by having one boat make more prolonged stops at the most

[1] Summary Report of the Geological Survey, Dept. of Mines, for the calendar year 1915. Ottawa, 1916, pp. 241.

[2] Narrative of a Journey to the Shores of the Polar Sea, in the years 1819, 20, 21, and 22. By John Franklin, Captain R.N., F.R.S., and Commander of the Expedition. London, John Murray, Albemarle Street. MDCCXXIII.

interesting points for geological work, while the launch could keep running more or less continuously on the coast traverse. In the latter part of August, the Evinrude motor on the umiak gave out, and as we were not prepared to re-babbitt the bearings, which had been cut out by some grit, we had to lay the umiak up for a while near Kater point, Arctic sound, as it reduced the speed of the launch about a mile per hour to tow the umiak, and the winds were not steady enough to keep up by sailing. With the umiak out of commission, Mr. Chipman found it necessary to stay in the vicinity of Kater point for about three weeks, and this cut down the topographic work considerably.

Previous to this the coast survey had been completed in detail from cape Barrow, around Detention harbour (a rather large bay nearly hidden by a large island nearly hiding the entrance; with a deep channel behind except at one narrow point near the eastern exit, where it narrows to about 100 yards in width and only one fathom of water). An investigation was made of the islands along the coast here and farther south in Moore bay. The islands from Gray's bay east were little granite outliners here and there near the coast, but north of Moore bay, and lying two or three miles outside of the Detention Harbour islands, are some rather large islands, called Nu-a-ho'-ngak by the Eskimos. The latter islands are stratified dolomite, cut by a large dike of diabase, which also runs inland on the mainland here. Moore bay is rather larger than indicated by the charts, with a rather deeper extension to the southeast and a number of high diabase islands. We found our first native copper *in situ* in cracks in the diabase on an island in Moore bay. Small veins of galena (lead sulphide, Pb. S.) were observed in cracks in the granite at Galena point, just east of Detention harbour. There is a river of fair size flowing into the southwestern point of Moore bay.

From Kater point, O'Neill, Cox, and I continued to carry on the survey with the launch down the west side of Arctic sound. Some difficulty was experienced in finding a channel into the mouth of Hood river through a number of low sandy islands at the mouth of the river, on account of a heavy sea running at the time. After entering the river we found a deep channel, 9 or 10 feet deep, following the high-cut bank along the south side of the river for 3 or 4 miles from its mouth. At the first large bend, the channel shifts to the left (west) bank, where there is a small exposure of quartzite at the water's edge, overlain by a thick deposit of light-coloured sandy clay. Willows on the bank here were 5 or 6 feet high, one inch or more in diameter, and quite a bit of dead willow in among them. Considerable willow drift was found on the banks, affording more fuel than was usual in this region. Going up stream from the quartzite bend, the channel gradually swung across to the other bank, but we had no difficulty following the deep channel (over 9 feet) by watching the colour of the water, which was grey over the shoals. We could take the launch up only to the first cascade of the Hood river, and camped there on August 27, making an inland reconnaissance in the direction of the James river. The steep clay banks of the river are about 100 feet high at the first cascade, with a level grassy bench extending back about half a mile to a ridge of fine, red sandstone, cut on the southwest side by a dike of coarse-grained basalt, with a broad grassy valley beyond. The next ridge was quartzite, succeeded by another grassy valley. A herd of thirty-four caribou was found here, and one fat young bull killed to replenish our meat supply. A single lone bull had been seen and killed at Kater point a few days before. A little farther on O'Neill struck an outcrop of granite, pegmatite, and mica schist in the valley, and established the continuity of the granite extending from Detention harbour and Moore bay down to Hood river. Going out of the river again the coast of Arctic sound was followed to its bottom. A fine large specimen of the Barren Ground bear was killed at the

south end of Baillie's cove, the extreme bottom of Arctic sound, where he was found digging roots from the sandy soil near the mouth of a small creek.

The east side of Arctic sound is formed by one side of Banks peninsula (Tikerayuk, or " the forefinger," of the Eskimos), its most northern point being point Wollaston. Native copper was found in amygdules on both sides of Banks peninsula. Running down the east side of Banks peninsula we expected from inspection of the chart to find a passage out through Franklin's so-called Brown's channel,[1] but found that the channel was a blind one, comparatively straight, with another peninsula, shorter than Banks peninsula, on the east side. The southerly portion of this hitherto uncharted sound is fringed for several miles on its west side by high cliffs of grey dolomite. Rather steep slopes of dirt and gravel lead up from the beach in about half a mile to 490 feet elevation. From the top of this slope, nearly vertical cliffs rise to a height of 870 feet above sea-level; composed of heavy strata of dolomite, with a heavy capping of diabase, much striated on the upper surface. Ascending to the top of these cliffs, a small creek was seen to run into the bottom of the sound from a lake about five miles inland, in a broad grassy valley to the southwest. We followed the coast around a series of long, narrow fiords, peninsulas, and small islands east of here, finding the coast line very slow and difficult to work out, being very much cut up in the region tentatively indicated by Franklin as Goulburn island, the latter being really a series of long peninsulas southeast of Banks peninsula. Having struck a considerable copper-bearing area in Bathurst inlet, it was thought better to make a detailed geological sheet of this important area than to attempt to make a complete survey of the bottom of Bathurst inlet outside of the copper area. We accordingly followed the southern boundary of the diabase area across to Kannuyuk (Copper) island, a large island in Bathurst inlet, south of the Barry islands, opposite Fowler bay, on the east side of Bathurst inlet. Driftwood was very scarce east of Kater point, but by picking up every small piece we saw on the beaches, we usually managed to carry enough in the boats to last us a day or two. Bird and animal life was remarkably scarce along the coast. Caribou signs were seen occasionally, and fresh tracks on some of the islands. A very fine large bull caribou was killed on Kannuyuk island, Bathurst inlet, by Mr. Cox on September 3. Numbers of gulls were nesting in rookeries near point Wollaston and on the south side of the Barry islands.

The Barry islands, instead of a single island, are really a group of large islands. The most easterly, called Ekullialuk, the Barry island of Franklin, is properly two large islands, separated by a bay or sound 4½ miles long and 2 or 3 miles wide, running north and south and opening to the north through a deep channel about one-quarter of a mile wide. This bay has several sharp, deep bays indenting its south shore, and several little stony islands near the shore. Cruising along the south side of the big island, along the foot of the precipitous cliffs of diabase, overlying red quartzite, we found an opening into the wall, through a channel about one-quarter of a mile long, one-eighth of a mile wide at the south end and about 100 yards wide at the north end, with a strong tide rip running to the southward when we passed through. In exploring the interior of the bay, we found Sir John Franklin's portage, discovered on his return boat voyage in August, 1821,[2] a passage between walls of almost perpendicular diabase about 100 feet high, but closed by a low, narrow gravelly isthmus about 30 yards across, across which he had to portage his canoes. There are in reality two isthmuses, separated by an " island " of steep rock, the western gravel isthmus being about 100 yards across, and the other narrower. As Franklin did not happen to strike the narrow, open channel about half a mile farther east, he assumed that the whole was a single island. Just northwest of the Ekullialuk

[1] Narrative of Journey to Polar Sea, in 1819–22. By John Franklin, Capt., R.N., etc. London, 1823, p. 375.

[2] Journey to Shores of Polar Sea, in years 1819, 20, 21, and 22, by John Franklin, p. 395.

islands, and separated by another narrow, deep channel is a large island called Adligaq, and north of Adligaq and extending some distance to the northeast of point Wollaston, is the large island called Igloruallig. The northeast tip of this group of islands approaches close to point Everitt on the east side of Bathurst inlet. The region around point Everitt is known as Umingmuktor, and is the centre of a fairly large group of Eskimos called Uminguktogmiut. The Eskimos who frequent the southern and western parts of Bathurst inlet are mostly Kilusiktogmiut, and this region in general is known as Kilusiktok.

As the season was getting advanced, we felt impelled to turn back from Ekullialuk (Barry island), Bathurst inlet, on September 8, 1915, without going to the bottom of Bathurst inlet. The geological results had been encouraging, for two large areas, each of several square miles in extent, were discovered, in which the native copper is widely distributed, and much valuable geological knowledge had been gained in tracing the contact of the basalts with the granites and sedimentaries throughout the region. The plan was made to complete the detailed mapping of the copper-bearing area by sledge the following spring by one party, while another party should fill in the gaps remaining in the coast survey west of Bathurst inlet. We were delayed by heavy weather from the evening of September 9 to the morning of September 14 on Adligaq island. On the 14th we succeeded in running as far as Cheere islands, at the entrance to Arctic sound, where a gale held us until the morning of the 16th, when we succeeded in slipping across to Kater point, where we joined Mr. Chipman. Here we were delayed for eight days, storm-bound in the fine little land-locked harbour. Strong northwesterly winds prevailed, with heavy snowfall and freezing weather. The ground was snow-covered, drifting to 4 or 5 feet in depth in the lee of bluffs and in gullies, while ice on small freshwater ponds was about three inches thick. The temperature of the air during this period ranged from 25° to 31° F., but the sea-water did not get down to freezing during our stay at Kater point, although we were anxiously watching for signs of slush ice. The 24th of September was warmer and quiet, and we succeeded in reaching cape Barrow that evening. Although the weather was otherwise fair, high winds kept us at cape Barrow until September 28. On the night of the 26th, young ice formed for the first time across the little harbour, but about half of it melted or floated out during the day. On the morning of the 28th the launch was run out through about 50 yards of young ice to clear a road to the open water outside. In doing this the ice sawed long holes through both sides of the boat about midships, the boat being only sheathed with tin forward. We were obliged to unload and haul the boat up on the beach high enough to clear the holes, so that we could patch it with tarred canvass and tin. We finally left the harbour at 10.45 a.m. and followed the coast pretty closely to the westward, keeping behind the very numerous small granite islands when possible, and cutting across the mouths of the numerous narrow bays and inlets with which the coast is indented. About 2.30 p.m. we were compelled to stop near the eastern end of Gray's bay, as the wind was too strong to cross the bay ahead. On the 29th we went ahead and entered the mouth of Wentzell (or Utkusikaluk) river a little after 1 p.m. There was a sandbar island at the middle of the entrance of the river and a 4-foot shoal in the channel, but after crossing this the river was 9 or 10 feet deep, with a width of about 100 yards. The coast near the mouth of the river is composed of fine sand mostly, supporting a little grass, wild barley, etc. Small granite outcrops show here and there, and there is a very rugged-looking range of hills two or three miles inland. We stayed only a short time in the river, catching two fine whitefish in a net while we were waiting. The river was rather muddy, but no ice was seen.

At 3.30 the wind moderated a little and we started ahead again, heading for a long point to the westward. The breeze freshening, we soon struck a heavy swell and shipped much spray. Running in towards the low shore, we

struck muddy water about one mile from shore and soon sighted some low sand islands at the mouth of the Kogluktuaryuk river. We tried to enter the eastern channel but grounded, and had to turn back and enter the middle channel. Quite a bit of loose, slushy ice was floating down stream and bunching up along the sides of the river mouth. Numerous fish were jumping out of the water. We found the river frozen completely across about 500 yards upstream. High, steep, black earth or clay banks begin about half a mile from the mouth of the river, running back probably two or three miles to the rocky hills. The roar of large water-falls could be heard from the mouth of the river. As the situation did not look favourable for camping, with no wood and a good prospect of a sudden freeze-up, we ran out of the Kogluktuaryuk, which is about south of the middle of Franklin's Hepburn island (known as Igluhugyuk to the Eskimos), and pushing ahead, camped long after dark on a small island off the mouth of the Annielik river (incorrectly indicated on Hanbury's map[1] as the Unialik). The Annielik river flows into the deep southwest corner of Grays' bay. The muddy water from the Annielik discoloured the waters of the bay for one or two miles from its mouth, and young ice was forming in crystals on the surface of the water in the evening, in calm places in the bay.

Leaving the mouth of the Annielik early in the morning of September 30, we passed the high sandstone cliffs on the west side of Gray's bay and reached a point about 15 miles east of port Epworth at 11 a.m. We were compelled to stop until 3.20 p.m. on account of a stiff breeze springing up, and reached port Epworth harbour, near our cache, about 8 p.m., at which time it was pretty dark. As the freeze-up of Coronation gulf was impending, we decided to stop at Tree river and return to the winter base at Bernard harbour with sleds. Stormy weather followed for four days and the young ice in the harbour was pretty thick on October 6.

We had taken our three best dogs with us on the boats during the summer, for use in packing trips inland and for tracking boats if necessary. Seven dogs and two sleds had been left in charge of some Eskimos at the first rapids about five miles from the mouth of the river, when Cox and O'Neill left this place July 30. We found that the natives had taken good care of our dogs, and the large fish-cache on the harbour island was intact, although wolverines had broken into the rock cache on the mainland and spilled out some flour and rice. Our natives here had just killed a number of fat caribou, and as by frequently dropping a net for fish, shooting caribou, Arctic hares, and other game when needed during the summer, we had been enabled to keep a large stock of reserve provisions on hand, we had no hardship in waiting at Tree river for about three weeks, until the ice of Coronation gulf became strong enough for us to start for home October 27, without following all the indentations of the coast. The Eskimo family which had accompanied Cox and O'Neill to Tree river in June accompanied us back to Bernard harbour. We reached the station November 9, 1915, and on that date received the first mail and news from the outside world that we had received for fifteen months.

Mr. D. Jenness, ethnologist of the Southern party, arrived at Bernard harbour on November 8, 1915, after having been with the Eskimos on Victoria island since April 13, 1915. He had started out with a small band of Eskimos, of whom the chief man, a middle-aged man named Ikpukhuaq, was engaged by Mr. Jenness as a helper. These Eskimos fulfilled all their promises and obligations to Mr. Jenness in a very kindly and creditable manner during the whole time he was with them. They spent most of the summer in the Colville hills in southern Victoria island, and did not go to Prince Albert sound, as had been anticipated. A few Prince Albert Sound Eskimos came to visit them in the spring, however. The party were moving most of the time, following the caribou, and

[1] Hanbury, David T. Sport and Travel in the Northland of Canada. London, 1904.

supplementing the caribou to some extent with fish caught in the lakes. They did not suffer from lack of food during the summer, but experienced considerable discomfort from being without fuel for either cooking or warming themselves for a good part of the time. Many districts visited did not afford a sufficient quantity even of dwarf willow or heather to make fires, and the people were obliged to eat their meat and fish in a raw state oftener than desirable. Mr. Jenness, however, had some very interesting experiences, and obtained a good understanding of the language, habits, folk-lore, and viewpoints on life in general, such as can only be obtained by continued intimate relations. During the winter he supplemented this with intensive studies of the winter snow-houses life, and many gramophone records of songs, shamanistic performances, and the like. Finger-prints of many of the people were recorded, and many of their string-games, or cats'-cradles were recorded.

The C.G.S. *Alaska* had arrived at Bernard harbour on September 5, 1915, after going from Baillie island to Herschel island for the mail and supplies. After discharging cargo, the *Alaska* went back west to Stapylton bay to look for drift-wood, as the amount of coal brought in was smaller than had been expected. Mr. Frits Johansen, marine biologist, had been in charge of the Bernard harbour station since the *North Star* had left on August 9, with only the cook and Patsy Klengenberg, interpreter, to help him. Mr. Johansen, who had been authorized, if conditions were possible, to do some dredging work on the *Alaska* after her return, accompanied the *Alaska* on the trip to Stapylton bay. He got some valuable deep soundings and dredgings in Dolphin and Union strait, down to a depth of 50 fathoms, and obtained a quantity of specimens from greater depths than he had been able to reach before. Mr. Johansen made continued studies of the fresh-water life of the ponds and lakes in the vicinity of the station, and made fairly complete collections of the flora and insect life. In the autumn he completed a series of soundings of the outer and inner harbours here, by means of holes through the young ice, in continuation of work begun in the autumn of 1914. The lines were run over the ice between islands and points of the main-land, with the soundings at paced distances, from 30 to 250 feet apart. The result was the finding of very interesting hydrographic conditions, the maximum depth inside of the islands being 12 fathoms. This information was of particular value in connection with his other marine investigations, and added materially to the topographic map of the harbour. Mr. Johansen also did some other hydrographic work in the neighbouring fresh-water lakes, by taking soundings through the young ice in the autumn.

The barren-ground caribou began to migrate across Dolphin and Union strait shortly after our return from the east, and were coming in fairly large numbers by November 15, 1915. About forty were taken before the end of the month (including about ten brought by Mr. Jenness from the south side of Victoria island), so a plentiful supply of fresh meat was on hand all winter. Salmon trout were also taken in some numbers up to the middle of December in nets set under the ice of the lakes near the station.

Captain Sweeney brought in the news that Mr. Daniel Wallace Blue, chief engineer of the C.G.S. *Alaska*, died at Baillie island, N.W.T., on May 2, 1915, after an illness of ten days. He had been troubled somewhat in the latter part of the winter by what Captain Sweeney thought was incipient scurvy. About the only noticeable symptom was that when his legs were punched with the finger, the indentations remained for a short time. Captain Sweeney and some of the natives at Baillie island had the same symptoms to some extent, as did also a trapper named Fred. Jacobsen who wintered around Liverpool bay, and Captain McIntyre and Mr. Arey on the *Argo* in Darnley bay. Mr. Jacobsen came over to Baillie island in the spring, and Mr. Blue accompanied him on a sled trip along the coast, after ptarmigan. They were all improving in condition as spring approached. A few days later, Mr. Jacobsen brought Mr. Blue back on the

sled, suffering from a severe congestion of the lungs. The pneumonic symptoms kept getting worse, and Mr. Blue died May 2. He was buried on cape Bathurst. Mr. Blue was one of the original crew shipped on the *Alaska* at Nome. He was a native of Ayrshire, Scotland, about 30 years old, and learned the steam engineering trade in Glasgow. He had lived in Alaska since 1906, and had followed the placer-mining industry (both prospecting and operating) on Copper river, Tanana, Nome, and Kobuk, Alaska. There was no other illness among the members of the Southern party, during the year 1915, except a slight illness of Mr. Jenness while he was spending the summer with the Eskimos on Victoria island.

Tidal observations were taken at Bernard harbour for a time in the spring of 1915, with the automatic tide-registering machine, but not very successfully, as the machine had a habit of stopping too frequently, and was finally discarded. In December, 1915, we secured tidal records continuously for one week, from December 4 to December 11; we erected a snow-house on the ice of Dolphin and Union strait, outside of the harbour islands, set up a long, graduated pole on the sea-bottom, and read the height of the tide every half hour, day and night, and at intervals of ten minutes or oftener around the periods of high and low tides. The maximum rise of tide recorded was about 2½ feet.

Only three or four families of Eskimos were around Bernard harbour in the late summer and early autumn of 1915, but about the middle of November they began to come up from the Coppermine River region, and from the south coast of Victoria island, until about 125 were living in a snow-house village on the beach near the station. Most of them stayed around for about three weeks, living principally on caribou meat, while their women were engaged in making new caribou-skin garments for the winter. All this work had to be done on land, as the natives of this region have superstitious taboos which forbid them dressing caribou-skins or making new caribou-skin garments while living on the ice. This was a happy time of the year for them, and there was singing and dancing going on most of the time. In the early part of December, when their new winter clothing was completed, and their stocks of frozen meat, dried meat, and fish began to run low, they all moved out to the vicinity of Liston and Sutton islands, in the middle of Dolphin and Union strait, about 16 miles north of Bernard harbour. The people build snow-houses on the ice there, and live practically exclusively on seals for the rest of the winter.

A good collection of mammals and birds was made around Bernard harbour in the spring and summer, and Mr. Jenness brought back a few zoological specimens from Victoria island. In the late summer I collected specimens at various points in the Bathurst inlet region. A good series of barren-ground caribou were collected during the autumn migration south from Victoria island. Some caribou specimens were obtained during the spring migration, some young fawns in June, and three good summer specimens, while we were in the eastern region. Specimens of fish were also taken whenever possible.

January and February, 1916, were spent by the geological and topographical men mostly in working up their field notes and preparing for the spring work. Mr. Jenness spent most of the winter at the large Eskimo sealing village near the Okullit (Liston and Sutton) islands, pursuing his ethnological studies. I made a trip to the first timber on the Coppermine river with some of the hunters in January and February, and a quantity of caribou meat was brought back to replenish the house supply, as well as a few specimens. Caribou were found to be fairly plentiful down to the coast near the mouth of the Coppermine river, and we also saw one small herd south of cape Lambert. Caribou are not often seen near the coast of Dolphin and Union strait in winter. The natives in this region spend the winter sealing through the ice, and at the present time do not molest the caribou from November until April.

At the outset of this trip, in January, I sent two of the Coronation gulf natives, named Mupfa and Kohoktak, in the employ of the expedition, to haul by sledge a quantity of provisions from the station at Bernard harbour to port Epworth, Coronation gulf, which was to serve as an outfitting base for Mr. Chipman's projected survey of the south side of Coronation gulf from the mouth of Rae river east to cape Barrow and for the return trip of the two or three sledges which would be working in the Bathurst inlet area until late in the spring of 1916. These two Eskimos, with their families, faithfully hauled and cached the goods safely, and on their return trip brought back to Bernard harbour several boxes of specimens which had been cached at port Epworth in the autumn. That spot was particularly favourable for making secure caches on account of the massive flat slabs of heavy shale lying loose on the island, affording ready material for making vermin-proof caches. Wolverines are surprisingly numerous on the coasts and islands of this region, far from the nearest timbered country, and nothing edible can be left long without being securely protected from them.

I returned to Bernard harbour from the Coppermine river trip on February 27, having been gone a little over a month. It had been arranged that K. G. Chipman should start on March 1 to make a survey of Croker river before starting the eastern work. This seems to be without doubt the largest river between Darnley bay and Coronation gulf, and nothing but its mouth had been put on the charts previously. I decided that I would accompany Mr. Chipman on this trip, which was of interest not only as giving an important geological section into the heart of the barren ground half-way between Mr. O'Neill's reconnaissance from Darnley bay, and Mr. Cox's traverse from the head of Rae river to Stapylton bay, but might also throw more light on animal distribution, particularly of the muskox. Owing to stormy weather we did not get away from Bernard harbour until March 6, and reached the mouth of Croker river on March 15. Near Clifton point we spent a night at " Camp Necessity," a little cabin built in the fall of 1915, by Rev. H. Girling, of the Anglican mission service, and his assistants, Mr. G. E. Merritt, of St. John, N.B., and Mr. W. H. B. Hoare, of Ottawa. They had intended to come farther east, but had been cast up with their little schooner nearly a hunderd miles west of the Eskimos they were intending to work among. Their schooner was apparently uninjured, and they expected to move in to Dolphin and Union strait in the summer of 1916, and establish a mission at Bernard harbour. The present western range of the Copper Eskimos extends usually to cape Bexley or South bay; west of that point is a 200-mile stretch of coast to cape Lyon permanently uninhabited, and usually uninhabited west to cape Bathurst, about 400 miles.

Croker river[1] has a broad delta, forming a triangle nearly equilateral, with base about 5 miles across at the coast, and apex about five miles inland, where the river emerges from a rampart of low hills. After leaving the hills, the river follows many devious channels, through many gravelly and stony bars and islands. There were a few small domes caused by ice rising up, but no recent signs of water flowing. The river seemed to be frozen to the bottom all the way up, so far as we could observe. The river is 60 to 70 yards wide where it emerges from the first rock (dolomite) cliffs about five miles from the coast. The cliffs a little inside the first bend of the river are about 60 feet high; they are composed of stratified dolomite, yellowish on the surface, but grayish on freshly broken surfaces, with some lighter-coloured bands, and lenses of calcite. The canyon walls on both sides became gradually higher inland, from 100 to 150 feet, vertical on both sides in most places. The river maintains a uniform width of about 60 yards, narrowing in one place to about 40 yards. Heavy snowdrifts overhung the west bank in many places (due to the prevailing winds), and there had been avalanches in places, making barrier ridges of very hard, ice-like, angular-

[1] Summary Report of the Geological Survey for 1916. Ottawa, 1917.

fractured snowblocks extending most of the way, and sometimes entirely, across the river. The river continually makes very short, sharp bends, but its general course is northerly. There are no tributary creeks entering the lower course of the river. At very frequent intervals the sides, walls, and brink of the canyon are castellated, or split vertically into sharp, angular, pointed pillars, spires, and minarets. One straight pillar in a bend of the river, was about 40 feet high and not over 3 feet thick at the base.

About 12 miles from the mouth of the river, and nearly 8 miles up the canyon, there is a broadening of the river where a large creek comes from the southeast, splitting to send a branch around a large, picturesque, pyramidal rock island about 300 feet high, before entering the river. This was the first place where we were able to get up out of the canyon and Mr. Chipman and I climbed to the top of the hill by cutting some niches and steps in the snowbanks. The top of the canyon walls were found to be 310 feet above the river, by aneroid, and the top of the ridge behind, 350 feet above the level of the river. We could see quite a bit of land on both sides of the river, and it appeared to be smooth, rolling upland. A little above this creek, the river narrowed abruptly to a gateway about 18 feet wide and over 300 feet high, and a little farther on to another gateway about 36 feet wide. Beyond this the river was wider, but the gorge was so much obstructed by avalanche barricades of icy-hard snowblocks that it was scarcely possible to take a loaded sled over them, so we decided to camp there, cache all but four days provisions, and scout ahead with a very light sled.

Before going farther up the river, we explored the tributary creek, got out of the creek canyon about 2 miles up and went up on the hills. The deep canyon of the river, cut down more than 300 feet through the dolomite, is not visible at a distance of more than half a mile. The country slopes gradually north to the coast of Amunsdsen gulf. The river canyon was seen to make a series of intricate bends a little above the creek, the loops coming nearly together. A little farther up, the river has quite a steep descent, with some rapids, if not waterfalls. The snowdrifts and ice barriers were so deep, however, in most places that it was impossible to see the character of the river. In some stretches of the river, progress was made only by climbing over one rugged hill of snow blocks, descending 20 or 30 feet into a deep pit, and immediately ascending another ridge, like working through pressure-ridge sea ice. We frequently had to boost and lift the sled up over ridges by main strength, and take the dogs out of harness to let the sled down. The rock strata are horizontal in most places, with some slight local variations of not more than 4 or 5 degrees. Quartz geodes, with brown and transparent crystals of topaz were frequent.

After going about 20 miles in the canyon, we came out suddenly on a snow-covered, hilly country, and at the mouth of a large creek coming from a northerly direction, about seven miles from mount Davy. A short distance south of the big canyon, there is another little canyon about three-quarters of a mile long and 20 to 30 feet deep, cut through dolomite overlain with gravelly knolls. At the upper end of the little gorge, the river cliffs are overlain with a sort of mud conglomerate—fragments of dolomite, granite and diabase, imbedded in yellowish-grey mud or clay. The tops of all the hills are covered with small stones, little angular fragments of dolomite, and a few boulders of granite and diabase. The ground is very barren everywhere, and gravelly where exposed through the thin crust of snow on the hill tops; no ground willows were seen on the hills, and only very scanty grass. Very rarely a single little sprig or two of willow would be found to have a foothold in a sheltered crevice in the bank of the river valley.

Mr. Chipman went to the top of mount Davy, which is the most conspicuous landmark from the coast from Inman river to some distance west of Croker river. He saw no rock exposures, the mountain being a hemispherical mound of gravel about 200 feet above the general level of the surrounding plain. Mount

Davy has an elevation of about 2,000 feet above sea-level by aneroid, agreeing very closely with its height as determined by triangulation from the coast. Some hills to the southward seemed to be higher than mount Davy. The Croker river valley extends comparatively straight to the south from this point for 10 or 15 miles. The hills south and southwest form a rather rugged-looking range, running approximately east and west. They are similar in appearance to the rather steep gravel ridges and knolls common along this coast, and no rock exposures could be seen. Above the little upper canyon, the river is rather broad for a distance, looking like a lake, and on the east side of this expansion is a low, broad, stony and gravelly flat. The only signs of life seen on the whole river trip were an Arctic fox track near mount Davy, a few Arctic hare tracks, and one hare which we killed. One raven was seen near the mouth of the river. We later learned from the missionaries that a few caribou came down to the coast a little east of here in the month of May. In 1915 we saw four caribou in May near Wise point, and one small bunch near Young point, but from the tracks it was evident that caribou were very scarce on the coast west of cape Bexley. The coast of this region seems to be too barren to afford sufficient pasturage for large numbers of caribou at any season. No signs of muskox were seen on the trip. We returned to the coast March 24, and reached Bernard harbour April 2. The coldest weather of the winter was recorded while we were in camp up the Croker river, 46 degrees below zero Fahrenheit at 6 a.m., March 21. The thermometer rose to 9 degrees below zero at 4.30 the same day. The minimum temperature at Bernard harbour the same day was 38 below zero, and the maximum 23 below zero.

D. Jenness, ethnologist of the expedition, accompanied by Mr. H. Girling, and Patsy Klengenberg, interpreter and assistant, left Bernard harbour February 15, and returned late in March. They visited a number of Eskimo villages on the ice of Coronation gulf east of cape Krusenstern (Nuvuk), near Tree river (Kogluktualuk), and near Hepburn island (Igluhugyuk), meeting a good many Eskimos that had not been seen before, and gaining considerable information in regard to the Kiluskitogmiut, who inhabit the Arctic sound and Bathurst inlet region usually in summer; the Havuktogmiut, from the central part of the coast of southern Victoria island; the Ekalluktogmiut, from farther east than the Havuktogmiut; and the Umingmuktogmiut from the eastern part of the Bathurst inlet region, and the Asiagmiut, from the same region and the eastern part of the Kent peninsula. They visited several villages on the ice about as far east as cape Barrow. A number of the eastern Eskimos came to the Bernard harbour station about the same time that Mr. Jenness returned, and many interesting gramophone records of the language and dialects were obtained. Earlier in the winter some Eskimos came from a greater distance to visit the station, notably a man named Kakshavik or Kakshavinna, calling himself a Pallirmiut, from the northwestern side of Hudson bay. He claimed to have come from a timbered country far to the eastward, and had traded at a white man's post, from his description apparently in the region of Baker lake or the Kazan river.

F. Johansen, naturalist, with Ovayuak (Eskimo) for companion, made a trip along the south shore of Victoria island, leaving the station March 6, and returning April 11, 1916. They crossed by way of the Liston and Sutton islands, Lady Franklin point, visited the Miles islands, and went along the Richardson islands as far as Murray point on the south shore of Victoria island. No Eskimos were seen except one group camped on the ice near cape Murray. He made such botanical collections as were possible at that season, took a few zoological specimens, and a number of specimens of rock at various points along the south shore of Victoria island. A few caribou were seen on southern Victoria island on March 19 and 21. The most important results of his trip were a number of species of fossil corals collected on one corner of Liston island in Dolphin and Union strait, as recognizable fossils are very hard to find in that whole region.

After his return, Mr. Johansen spent the rest of the season in completing his biological investigations near Bernard harbour, and in packing specimens and equipment preparatory to going out. His collections of plants and insects were practically complete for the region, and he made considerable additions to his collections and studies of fishes and marine and fresh-water invertebrates.

John J. O'Neill, geologist, and John R. Cox, topographer, started from Bernard harbour on March 17, 1916, to continue the survey of the copper-bearing area in the Bathurst inlet region. They took two sleds with them, so that they could work separately when desirable, and provisions for about ten weeks. They had for assistants, Ikey Bolt, an English-speaking point Hope Eskimo who had been with the expedition for over two years, and a Coronation gulf Eskimo with his family. Both the man and his wife had proved very useful in working, and they were familiar with the Bathurst inlet territory. O'Neill and Cox succeeded in cleaning up the work pretty well as planned. Tracing the southern contact or the copper-bearing diabase with the older rocks to Kannuyuk island, it was not thought advisable to waste the limited time at the disposal of the party in running a coast survey line to the southern tip of Bathurst inlet (which runs some distance south of the Arctic circle), and the time was spent in making a more complete geological sheet of the mainland and islands in the upper northwestern portion of Bathurst inlet. Over 200 islands were mapped in the region generally covered in the charts by Chapman, Lewes, and Marcet islands. The group consists of many small rocky islands which at a little distance have the appearance of forming a continuous coast line.

They found practically no game in that region in March and the early part of April, and no natives living much south of cape Barrow at that season. The natives say that the sealing is very poor in Bathurst inlet in winter and the people have to go out on the ice farther north and west in Coronation gulf. The season in Bathurst inlet seemed to be much later than it was in Dolphin and Union strait in 1916, as the seals did not begin to come up on the surface of the ice in Bathurst inlet until about May 20. The provisions of the party held out well, as they obtained plenty of caribou after the end of April. For fuel they used mostly distillate from the cape Barrow cache, burning it in Primus stoves, but later in the spring used dwarf willows from some of the islands. Early in the season they found the Eskimo snow-house and blubber-lamp useful and comfortable on occasion.

The work of O'Neill and Cox in March, April, and May, 1916, completed the survey east of cape Barrow practically as planned. Mr. O'Neill summarizes the results of the work in that region as follows:[1] " The copper-bearing rocks in Bathurst inlet occur on most of the islands west of a line running northwest-southeast from the east side of Lewes island, and north of Kannuyuk island. They cover most of the Banks peninsula and the western mainland shore from the mouth of Hood river to Moore bay, extending as much as 5 or 6 miles inland from the coast. These rocks are amygdaloids and form several successive layers which represent progressive, intermittent effusions of lava. Nearly all of them are impregnated with native copper over wide areas. The copper occurs in veins and in amygdules, and is disseminated as pepper throughout the groundmass. I have made a very conservative estimate of the amount of this copper-bearing rock (in which I actually saw native copper) and it seems that two billion (2 x 108) tons is well within the limit. It will be necessary to wait for analyses, and for the plotting of the map to give a close estimate of value of these deposits."

Kenneth G. Chipman, with Eskimo camp assistants, and Corporal W. V. Bruce, R.N.W.M.P., as voluntary aide, left Bernard harbour on April 12, 1916, to finish the survey of the south side of Coronation gulf east from the mouth

[1] Summary report of the Geological Survey for 1916, Ottawa 1917.

of Rae river (where John R. Cox left off in 1915) to cape Barrow. Mr. Chipman completed the survey up to cape Barrow by May 20. The Bathurst inlet survey parties were met here at an appointed rendezvous, and we all went west together to the mouth of the Coppermine river.

After returning from the Croker river survey trip, I spent some time at the station arranging for the spring work and getting all accumulated zoological specimens taken care of before warm weather should set in, and finally started east with a sled and one Eskimo boy as an assistant, to make a trip into the Arctic sound and Bathurst inlet region to investigate the occurrence of the muskox, and other distributional problems of the fauna, as well as look up and assist the various surveying parties on their return. Mr. J. E. Hoff, chief engineer of the *Alaska*, with Mike, his Siberian Eskimo assistant engineer, went along as far as the mouth of Tree river, where they took out the launch motor and the Evinrude motor, and hauled them back to Bernard harbour. The hull of the launch was abandoned as it was badly worn and cut up, and the skin umiak was left for the last sled party to take back. The skin cover of the umiak had been removed the previous autumn, folded up and placed in a cache of slate slabs to protect it from vermin during the winter, and only needed to be soaked up and stretched over the canoe-frame again. The skin umiak is a very practicable means of crossing leads in the early summer, and I considered it advisable to have it on board the *Alaska* in case of accident in ice-crushes when travelling to point Barrow. The umiak is light and may be readily hauled over the ice where a wooden boat would be stoven.

The snow began to melt on the land much earlier than we had anticipated, being pretty soft by May 19, and I could not make the projected inland trip south of Arctic sound. I met O'Neill and Cox in Bathurst inlet, east of point Wollaston, and returned to cape Barrow with them, meeting Mr. Chipman's party again on May 21. There was much water on the ice around cape Barrow May 21, and much slushy snow and water until we got back to Tree river. We remained at the island at the entrance of the harbour from 3.45 a.m., May 25, until 10.30 p.m., May 27, putting the umiak in shape and getting some dog pack-saddles made for Mr. Chipman. Mr. Chipman had met the Royal Northwest Mounted Police patrol from Great Bear lake near the mouth of the Coppermine river early in the month, and arrangements had been made that he should go back to Great Bear lake overland with Mr. D'Arcy Arden, who had come down with the police patrol. Mr. Chipman wanted to go out by the overland route because his work here was finished, and the prospect was good that he could get out a little sooner by fort Norman and the Mackenzie river, and it was desirable to have news of the Southern party's condition and welfare get outside, in case the remainder of the party on the *Alaska* should be prevented by shipwreck or ice conditions from getting out by way of point Barrow and Nome, Alaska. Mr. Chipman reached the end of the telegraph line at Peace river crossing on August 18, and Ottawa about the end of the month.

It was evident that Franklin was labouring under a misapprehension when he applied the name of Tree river to the river flowing into port Epworth. The Eskimos call this river Kogluktualuk (river with big rapids.[1] In describing his interview with the aged Eskimo Terreganoeuck, or the White Fox, near the mouth of the Coppermine river, June 16, 1821, he says: " He had no knowledge of the coast to the eastward beyond the next river, which he called Nappaarktok-towock, or Tree river." Franklin accordingly charted the next river which we observed as Tree river, about 65 miles east of the mouth of the Coppermine. The old Eskimo was evidently referring to the small river which they still call Naparktoktuak (na-park-tok—spruce tree), flowing out through steep clay hills about 10 miles east of the Coppermine. I crossed this stream in the

[1] Narative of a journey to the shores of the Polar Sea, in the years 1819, 1820, 1821 and 1822 by John Franklyn, Captain, R.N., F.R.S., and Commander of the Expedition. London, 1823, p. 352.

spring of 1911 while making a portage from the mouth of the small Kogaryuak river (18 miles east of the Coppermine) to Bloody fall, and found a few small spruce growing in the valley within 10 miles of the coast, several miles north of the northern limit of trees on the Coppermine river itself.

Sending one large sled load of specimens with some of our Eskimos directly from port Epworth to Bernard harbour via cape Krusenstern, we started west at 10.30 p.m., May 27. West of port Epworth we found that most of the melted snow water had drained off through cracks in the ice, making sled travel much better. The section of the coast from the Coppermine river to port Epworth as mapped by Mr. Chipman in 1916, lies substantially as indicated on the old charts. The only rivers of any consequence are the big Kogaryuak, emptying about 25 miles west of port Epworth, and a smaller stream, also called Kogaryuak by the natives, flowing into Coronation gulf about 18 miles east of the Coppermine. In 1910-11, Capt. Jos. F. Bernard wintered inside the mouth of the latter river with the schooner *Teddy Bear*, drawing about 6 feet of water. All these rivers have falls or rapids a few miles from the coast. East of port Epworth, considerable rectification of the chart was made around Gray's bay, locating the Annielik, Koguktuaryuk, and Utkusikaluk (Wentzell) rivers, and several long narrow inlets and many granite islands between Gray's bay and cape Barrow. A point of interest was the great length of the inlet at Inman harbour, a very deep, narrow fjord, the bottom of which is separated by a low portage of half a mile from another deep inlet running in from the east side of cape Barrow, between cape Barrow and Detention harbour, nearly making an island of the cape Barrow peninsula. For the convenience of future travellers, we have adhered to the policy of retaining the native place names where these can be ascertained, but as this inlet seems to be unnamed, we propose the name Desbarats inlet, in honour of the Deputy Minister, Department of the Naval Service, who directed the general affairs of the expedition, and to whose careful and continued attention and interest the members of all the parties are deeply indebted.

The united sledge parties returned together along the coast as far as the mouth of the Coppermine river, which was reached on the morning of May 31. The river was open to its mouth, and was flooding the ice for about half a mile outside of its mouth. About 125 Eskimos were encamped a little west of the mouth of the river, on the southeast shore of Richardson bay. Most of them were preparing to start packing overland to Dismal lake and Dease river, although two or three families were intending to spend the summer hunting caribou around the Rae river, and three or four of the least enterprising families and some older people were intending to spend the summer spearing fish at the rapids of Bloody fall, about nine miles from the mouth of the river. Mr. Chipman and Mr. Arden left the mouth of the Coppermine river on June 1, to pack across country to Great Bear lake with some good pack dogs, while the rest of our party started at the same time to the station at Bernard harbour, going a little out of the way to re-examine some geological formations at cape Kendall and cape Hearne, on the west side of Coronation gulf. Part of the way we had to wade through about one foot of water on the ice, but after passing north of cape Hearne, the weather turned cooler and froze a crust on the fresh water which was on top of the sea ice, strong enough to bear up our sleds, and travelling was more easy. Considerable stretches of open water were seen south and west of Lambert island June 5 and 6. The ice is said to be very thin there even in winter and opens up very early in the spring. Great numbers of Pacific and King Eider ducks were seen in the water and on the ice at the water's edge. We reached Bernard harbour June 6, and found everybody well except Captain Sweeney, who had injured his hand while working on the ship. The wound became infected and his arm was badly swollen and had to be operated on several times, so that he did not recover the use of it for several weeks.

Mr. George H. Wilkins, with the Herschel island Eskimo Palaiyak, reached Bernard harbour on June 15, 1916, having come by sled from the headquarters of the Northern division of the expedition, near the Princess Royal islands, Prince of Wales strait, coming down the southern part of that strait, and crossing Minto inlet, Prince Albert sound, and Dolphin and Union strait. Mr. Wilkins brought news of the safety of the three vessels of the Northern party, and of the progress of their operations up to May 5, 1916. The *Mary Sachs* was still at cape Kellett, southwestern Banks island, where she had been hauled up since 1914, in charge of Capt. Peter Bernard, with some Eskimo assistants. The *North Star* had been hauled safely up on a small island north of Robillard island on the northwest coast of Banks island in the autumn of 1915, and the crew had gone over to join the *Polar Bear* party in the winter. The *Polar Bear* had attempted to go up through Prince of Wales strait on the east side of Banks island, but was unable to get beyond Armstrong point, and wintered between Armstrong point and the Princess Royal islands. At the time Mr. Wilkins left in May, Mr. Stefansson contemplated carrying on his travels on the northern islands until 1917, the *Polar Bear* having been directed to move its base to Winter harbour, Melville island, to spend the winter of 1916-17, with the possibility of the party remaining in the Arctic until 1918. The Northern party was stated to have provisions for one or two years more, and were killing and storing away large numbers of caribou and muskoxen on Melville island in the spring of 1916. Quite a number of their engaged western Eskimo hunters had been sent up to Melville island early in the spring to shoot caribou and muskoxen for the party's meat supply.

The remainder of June and the early part of July were spent in completing collections in the vicinity of Bernard harbour, and assembling and packing specimens, stores, and equipment for shipment out of the Arctic. Space had to be economized on the *Alaska* going out, as far as Herschel island, as we had to bring out twenty-seven people on the small schooner, viz., eleven white men, including six members of the scientific staff, a crew of three, and two members of the Royal Northwest Mounted Police; fourteen Eskimo employees, seven men, three women, and four children; and two Eskimos held by the Mounted Police for homicide. In addition to this we had to take the Eskimos' personal camp gear and dogs, stores for paying off native employees at Baillie island and Herschel island, and enough reserve provisions to provide for the wintering of as many men as might remain with the *Alaska* to take care of the vessel and bring her out the next year in case we should be prevented by ice conditions from sailing from Dolphin and Union strait to Nome in the summer and autumn of 1916. I also thought it necessary, for the same reason, to keep the skin umiak, two sleds, and two teams of dogs on board at least as far as point Barrow, Alaska.

In September, 1915, Corporal W. V. Bruce, R.N.W.M.P., came in from Herschel island, Y.T., on the return trip of the C.G.S. *Alaska*, to work on the case of the disappearance of Father Rouvier, O.M.I., and Father LeRoux, O.M.I., from the Mission at fort Norman, who had gone into the country northeast of Great Bear lake in 1913, and had not been heard of since.[1] Corporal Bruce had spent the winter working on the case, and with the assistance of various members of the expedition, gained considerable information and recovered a quantity of the personal effects of the missing fathers as well as some property which presumably belonged to Messrs. Radford and Street, who were killed by Eskimos in Bathurst inlet in 1912. In May, 1916, Inspector Charles D. LaNauze, of the Great Bear lake patrol,[1] came down to Coronation gulf with a party from his winter quarters near old fort Confidence on Dease river, and in the same month the police made prisoners of the two Eskimos, Sinnisiak and Uluksuk,

[1] Report of the R.N.W.M.P. for 1916. 7 George V., Sessional Paper No. 28. A. 1917. Ottawa.

who had killed the priests. Uluksuk was taken on one of the islands near the mouth of the Coppermine river, and Sinnisiak was taken on the south coast of Victoria island. Both prisoners were taken to Bernard harbour, and in July we took Inspector LaNauze and Corporal Bruce out as passengers on the *Alaska* from Bernard harbour to Herschel island. All relations of the Royal Northwest Mounted Police with the expedition have been most cordial, and while with the expedition, both Inspector LaNauze and Corporal Bruce did everything they could as volunteer assistants in whatever work was going on. The members of the expedition have also had many courtesies and much assistance in their work from Inspector J. W. Phillips, who was in command of the R.N.W.M.P. detachments at Herschel island and fort McPherson from 1913 to 1916, and from the members of his command, for which we are very appreciative.

The *Alaska* left a large permanent cache of provisions in the house formerly occupied by the Southern party at Bernard harbour, in case any parties should come down from the Northern party during the next winter. The house was left in custody of the Rev. H. Girling, who wintered near Clifton point with the mission schooner *Atkoon*, and intended to establish a mission station at Bernard harbour in the summer of 1916. This ensured our cache being protected from marauding natives.

The Hudson's Bay Company's schooner *Fort McPherson*, with Mr. W. G. Phillips in charge, sailed from Herschel island July 28, 1916, after our arrival there, for the purpose of establishing a permanent trading post for the company at Bernard harbour. As there are now trading posts of the Hudson's Bay Company at Herschel island, at Kittigazuit (east branch of the Mackenzie delta), at Baillie island, and Bernard harbour (the latter post having been satisfactorily established, from later advices), any parties from the Northern party of the expedition who may come to the mainland coast east of Herschel island will have little difficulty in getting provisions. The larger part of the Canadian Arctic Expedition stores remaining at Herschel island were mostly landed by the *Ruby* in 1915, after the *Alaska* had taken her required stores and sailed east again in 1915, and Mr. Stefansson's vessels had also taken what they were able to carry.

The work of loading the *Alaska* was begun in the summer of 1916 as soon as the vessel was loose from the ice in which she had been frozen all winter, and we succeeded in getting out of Bernard harbour much earlier than was anticipated. In the summer of 1915, prolonged northwesterly winds in the latter part of July had caused a local jam of ice in Dolphin and Union strait, and the *North Star* was not able to get away from Bernard harbour until August 9. The *Alaska*, with all members of the Southern party on board, left our headquarters for the past two years, at Bernard harbour, 7.30 p.m., July 13, 1916, and after working through some loose areas of bay ice, reached the vicinity of Young point on July 17. Here we met with masses of heavy floating ice, too heavy for us to make progress through. We were delayed near Young point for several days, tying up to heavy grounded cakes of ice along the beach, and were obliged to shift our position frequently, because the ice floes behind which we were sheltered shifted their position frequently as the tide rose and fell. The smooth rock bottom along the coast in this region prevented the big ice masses from grounding as hard and fast as they are accustomed to do on the mud and sand bottoms which are found west of cape Bathurst.

We got under way again in the evening of July 21, and worked out into a broad lead of open water outside the strip of loose, moving masses of ice which was pressing down along the mainland shore of the south side of Amundsen gulf and Dolphin and Union strait. After getting through this shore ice, we found it did not extend much west of Croker river, and that the ocean was practically open to the westward. We reached Pierce point harbour about midnight on

July 23, crossed Darnley bay and reached cape Parry on the morning of July 24. We stopped at cape Parry for a short time to get a time observation, and then went ahead across Franklin bay, reaching cape Bathurst at 10.05 p.m. the same evening. The Eskimo village and the new trading station of the Hudson's Bay Company, the most northerly trading post in Canada (70° 35′ north, 128° 05′ west) is at the tip of the long sandspit running west from cape Bathurst, about half a mile east of the east end of Baillie island.

At Baillie island, I discharged and paid off Ikey Bolt or Angatitsiak (point Hope Eskimo), Mungalina (Baillie island Eskimo), and Patsy Klengenberg, interpreter and general assistant. The latter, the 17-year-old son of Capt. Christian Klengenberg, is an extraordinarily intelligent and resourceful young man, a very capable hunter and traveller, showed great aptitude in the collection and preparation of specimens, and is probably the best qualified Eskimo interpreter in the country, being familiar with all the dialects from point Barrow to Coronation gulf. The people who left at Baillie island were paid principally in stores. There was a heavy northwest gale while we were in the shelter of the cape Bathurst sandspit on July 25 and 26. We left Baillie island at 7 p.m., July 26, and reached Herschel island 2.30 p.m., July 28, having been bothered very little by ice anywhere west of Croker river.

At Herschel island I landed some surplus stores from the *Alaska*, including 1,050 pounds of pemmican, 250 pounds rolled oats, 1 barrel beef, 412 pounds tobacco, and some miscellaneous equipment, storing them with the other expedition stores at Herschel island, in charge of the Royal Northwest Mounted Police, retaining on board the *Alaska* enough provisions to winter a certain number of men in case the vessel should be caught again by ice on the north coast of Alaska. I made as complete a survey of Canadian Arctic Expedition stores at Herschel island as the time would permit. The provisions there at the time we left, exclusive of a certain amount set aside to be shipped to Banks island, were as follows:—

	Pounds.
Rolled oats, 108 50-lb. cases	5,400
Sugar, granulated, 6 50-lb. boxes	300
" 5 200-lb. boxes	1,000
" 20 100-lb. brls	2,000
Dog biscuit, 11 50-lb. cases	550
Cracklings, 55 50-lb. cases	2,750
Rice, mostly brown, 36 50-lb. cases	1,800
Beef, 1 brl	100
Total	13,900

Acting in consultation with Mr. George H. Wilkins, who had recently come down from the Northern party, and was conversant with their resources and their needs, we set aside certain provisions, and other equipment, amounting to about two tons weight, and requested the commander of the R. N. W. M. P. detachment at Herschel island to try to get any whaling or trading ship which might come in during the summer of 1916, and intended to cruise in the vicinity of cape Kellett, Banks island, to take these goods on board and try to land them for the Northern party of the expedition at cape Kellett, Banks island, securing as good rates for this freighting as he could. I have later received information from the police at Herschel island, that the selected goods were taken by Capt. C. T. Pedersen, steamship *Herman*, of San Francisco, and landed at cape Kellett, Banks island, in the latter part of August, 1916. Capt. Pedersen made the very reasonable rate of $50 per ton for two tons from Herschel island to cape Kellett. It was also stated that Capt. P. Bernard of the *Mary Sachs* had purchased a

considerable quantity of additional supplies from the *Herman*. The stores which were shipped from Herschel island to cape Kellett included:—

	Pounds.
Pemmican, man, 17 50-lb. cases	850
" dog, 4 50-lb. cases	200
Cracklings, 20 50-lb. cases	1,000
Rolled oats, 6 50-lb. cases	300
Brown rice, 6 50-lb. cases	300
Sounding wire, 1 coil.	
Miscellaneous equipment.	
Mail for the Northern party.	

I am informed that Capt. Peter Bernard intended to make a sled trip from cape Kellett to Winter harbour, Melville island, in the fall of 1916 to bring up the mail which was sent in during the summer of 1916 to the Northern party.

At Herschel island, Yukon Territory, I discharged and paid off the remaining Eskimos in the employ of the Southern party, including Mike and his wife; Ambrose Aganvigak and his wife Unalina; Adam Ovayuak; and Silas Palaiyak; paying them as far as possible in stores remaining on the *Alaska*, and partially in cash. The *Alaska* left Herschel island for the westward on August 3, 1916, at which date no ship had yet arrived at Herschel island from the westward. We had on board nine men: Daniel Sweeney, sailing master; J. E. Hoff, chief engineer; James Sullivan, cook; scientific staff consisting of J. J. O'Neill, geologist; J. R. Cox, topographer; D. Jenness, ethnologist; F. Johansen, biologist; George H. Wilkins, cinematographer and photographer; and Rudolph M. Anderson, zoologist, in command.

Very little ice had been seen east of Herschel island, but we soon found it pretty heavy a little west of the island, although loose and moving freely, practically all the way west from the international boundary (141st meridian) to point Barrow, Alaska. We stopped long enough at the international boundary monument to get a time sight. One ship was seen on the way in, the *Herman*, but we could not speak to her as she was in the moving ice outside of Cross island, Alaska, on August 5, 1916, while we were inside of the chain of islands which includes Cross island. On account of the heavy ice outside, we again availed ourselves of the knowledge of the very excellent detailed sounding and charting done recently by Mr. E. deK. Leffingwell, and went into the inside passage behind the chain of low, sandy islands west of Flaxman island, coming out again between Midway island and Return reef. The channel inside of these islands is rather shoal, but is valuable for vessels drawing not more than two fathoms. A vessel of that draught could come in behind Flaxman island, but shoals prevent a vessel drawing more than 5 or 6 feet going out through the channel between the east end of Flaxman island and the mainland, that channel being shoal and foul from silt deposited by the Canning river. The pack ice was pretty heavy around point Barrow, and we had some difficulty in getting through, but after passing cape Smyth, about five miles southwest of point Barrow, no more ice was seen.

We left cape Smyth, which is the site of the village, including trading station, mission, government school, and the post office of Barrow, Alaska, the most northerly United States post office, on August 8, 1916. No ice was encountered south of cape Smyth, and we had a good run down to point Hope, where we stopped for a short time on August 10. Continuing across the outside of Kotzebue sound, we reached cape Prince of Wales and passed through Bering strait into Bering sea at the beginning of a heavy, prolonged northwest gale, on the evening of August 11, 1916. As the gale continued we were obliged to anchor for some time under the bluffs at cape York and Tin City, and again behind Sledge island, reaching Nome roadstead about 5 a.m., August 15, 1916.

The *Alaska* had not been leaking at all before passing point Barrow, but after passing that point began to leak badly around the stuffing-box; this

necessitated considerable pumping to keep the engine room from being flooded and put out of commission. Although the weather was a little rough when we reached Nome, I succeeded in getting the cargo of specimens and stores lightered ashore that day and put on the wharf of the Alaska Lighterage and Commercial Company. It was too rough to make any repairs on the vessel, and as the weather was rougher the next day, August 16, the *Alaska* was compelled to run 16 miles over to the shelter of Sledge island again. Three sailors had been temporarily engaged upon our arrival at Nome, and the six members of the scientific staff were relieved from seaman's duty and allowed to go ashore. They had all been doing watch as deck officers from Bernard harbour to Herschel island with our Eskimo crew, and from Herschel island to Nome the duties had been much heavier. The storm abated somewhat on August 18, and the *Alaska* returned to the roadstead, but the surf was still too heavy to make a landing. The *Alaska* was ultimately hauled up high and dry on the beach at Nome and left in the charge of the Alaska Lighterage and Commercial Company for final disposal by the Department of the Naval Service. The vessel was in good shape, except for the engines, the leakage around the stuffing-box being a trifling matter, which could be readily repaired when the vessel was hauled up.

The extensive collections made by the party in geology and mineralogy, ethnology, and archaeology, terrestrial and marine biology, botany and photography, and the records and papers of the Southern party, were thus landed safely at Nome. As it was considered much safer to ship the results of our three years' work out by the regular freight and passenger service from Nome than to risk taking them down on the north Pacific to Victoria on a small schooner like the *Alaska* in the autumn season, all the collections, scientific instruments, and what equipment was worth shipping back, was trans-shipped to Seattle on the steamship *Northwestern*, of the Alaska Steamship Company. The members of the party also took passage to Seattle on the same steamer, leaving Nome August 27, and reaching Seattle via the inside passage on September 11, 1916. All collections had been safely received in Ottawa by the end of October, 1916.

To summarize: The scientific work of the Southern party was completed substantially as outlined in our plans of last year, and although some time was lost on account of adverse ice conditions in 1913, all members of the party feel that in the main the results of their work, for the past two years at least, have been as satisfactory and extensive as they anticipated, considering the difficulties which are to be encountered in working in such remote fields.

The two topographers of the Southern party, Kenneth G. Chipman and John R. Cox, have completed the survey of the mainland coast in detail, on the scale of 10 miles to the inch, from the Alaska-Yukon Territory international boundary (the 141st meridian) to the Mackenzie river, made a traverse of Firth river, Y.T., surveyed the eastern and western branches of the Mackenzie delta, and the mainland coast from the west side of Darnley bay (on the Cape Parry peninsula) to a point well down in Bathurst inlet (south of Kannuyuk island), including a large number of islands in the Coronation gulf and Bathurst inlet regions, all on the same scale. Several of the hitherto unexplored rivers in this region have been traversed, including Hornaday river flowing into the south side of Darnley bay, Croker river flowing into the Amundsen gulf, Rae river flowing into the west side and Tree river (Kogluktualuk) flowing into the south side of Coronation gulf, and an examination made of the territory around the mouth of Hood river flowing into Arctic sound. Collinson point harbour, and about 10 square miles surrounding it, and Bernard harbour, Chantry island, and the country immediately surrounding these places have been surveyed on the scale of $\frac{1}{24000}$, and mapped with 20-foot contours. The geological features have been investigated by J. J. O'Neill, and the relations of the different formations studied in detail at the most important points of contact.

The most important result of the geological investigations was the detailed mapping and estimation of the available copper-bearing rock in a great new area hitherto very slightly known in the Bathurst inlet region. So far as analysed, the ore is low-grade, but further prospecting may locate veins and richer areas to render mining operations more profitable. Isolated nuggets of float copper of considerable size are found in the region. Galena was found by the party, and other minerals doubtless occur. The whole region forms a great copper reservoir for Canada, and will no doubt be utilized in the future, when transporation problems are solved, as they are not farther north than paying properties in Alaska and Norway, and much farther south than working mines in Spitzbergen. The climate is not too bad; there is a summer of about four months, and the snowfall is light in winter.

D. Jenness, ethnologist and anthropologist of the party, has made extensive ethnological collections, from Arctic Alaska as well as in the Coronation gulf, Dolphin and Union strait, and Victoria island region, and also about one hundred gramophone records of folklore, language, dance songs, and shamanistic performances, with careful transcriptions and translations of them. He has made a collection of cats'-cradle games from the different Eskimo tribes, numbering over one hundred and forty. Their language and vocabularies, the manners, social and religious customs, games, amusements, and general culture have been carefully studied and the information recorded. With the present rapid advance of civilized ideas and customs into this particular region, it is certain that much of this information could not be obtained at a later time. The habits of the Eskimos are changing with a rapidity which is astonishing to those not conversant with the situation; improved weapons and methods of trapping reduce the game and compel shifting of tribal localities, while from the history of the past, it seems very likely that contact with the fringe of civilization will rapidly decimate the numbers of the Copper Eskimos as it has done to the Eskimos farther west.

F. Johansen, marine biologist, entomologist, and botanist, has made extensive collections in all these branches, from Arctic Alaska and Canada. He has succeeded in rearing and working out the hitherto unknown life-histories of a number of little-known Arctic insects, and made many interesting and successful sea dredgings and soundings. George H. Wilkins has made many studies with camera and cinematograph, making over one thousand film and glass plate negatives and about 9,000 feet of cinematograph exposures, of Eskimo life, natural-history objects, and Arctic scenery and topography. All the members of the scientific staff made numbers of photographs also to illustrate their work.

In mammalogy and ornithology, fairly complete collections were made in the regions traversed, although the difficulties of transportation and the pressure of other duties often prevented the obtaining of as large series as might be desirable. The collection of birds numbers six hundred and nineteen (619) specimens, including seventy-three (73) species. The collection of mammals numbers four hundred and thirty-one (431) specimens, including twenty-two (22) species and probably several more subspecies. It is not possible to tell without more detailed examination whether any new forms are represented, but many specimens represent seasonal changes of plumage and pelage which are rare in collections, and the specimens taken will largely extend the geographical range of a number of species. This branch of the work was in charge of R. M. Anderson, but all members of the expedition aided materially in bringing in specimens and notes.

A mere list of the different groups represented in the expedition's biological collections indicates something of their scope:—

Mammals, birds, fishes, insects, plants, crustaceans, echinoderms, sponges, cirripedes or barnacles, molluscs, hydroid zoophytes, medusæ and ctenophores, alcyonarians and actinians, algæ, protozoa (foraminifera and radiolaria), plankton, sporozoa, diatoms, infusoria, pteropods, cephalopods, decapods,

phyllopods, copepods, schizopods, amphipods, isopods, pantopods, annelids, platyhelminthes, rotatoria, nematodes, nemertines, malacostraca, bryozoa, ascidians, peridiniales, ostracods, hirudinea chaetognatha, polychaeta.

On the biological side, to arrange for having the different groups worked up and the reports adequately published, an Arctic Biological Committee has been appointed jointly by the Department of the Naval Service and the Geological Survey, with the Dominion Commissioner of Fisheries, Prof. E. E. Prince, as chairman; Prof. A. B. MacCallum, of Toronto; the Dominion Entomologist, Dr. C. Gordon Hewitt; Mr. James Macoun, botanist, of the Geological Survey and R. M. Anderson, representing the expedition and the zoological division of the survey. The specimens to be worked up represent over forty distinct groups, each of which will require a separate chapter or report. Some of the larger groups, such as the insects, have been divided among several different men, mostly in the entomological division of the Department of Agriculture. A great many of these collections represent specimens of groups which have never been collected anywhere in the western Arctic area, and practically all of them are from districts and localities which are practically unrepresented in collections anywhere, from regions never visited before by a collector.

As far as possible these collections are being worked up by Canadian specialists, but some groups have necessarily been sent away because there was no satisfactory material in Canada for comparison. The Smithsonian Institution is well supplied with Alaskan Arctic material in some groups, and the British Museum with material from various Arctic expeditions, while the Greenland region is best represented by Danish and Norwegian collections, consequently a number of groups of specimens are being sent to some of those countries for determination. When the collections have been properly determined and worked up, Canada's museum will have a good start in the representation of the production and content of a very large area that has hitherto been very poorly represented. The specimens are being placed in the hands of the best available specialists, and these men have shown a gratifying willingness to do what they can to help unravel the problems presented so that we have satisfaction in knowing that such additions to knowledge as were obtained by the Canadian Arctic Expedition of 1913-16 may soon be made available to the public of Canada and to the world.

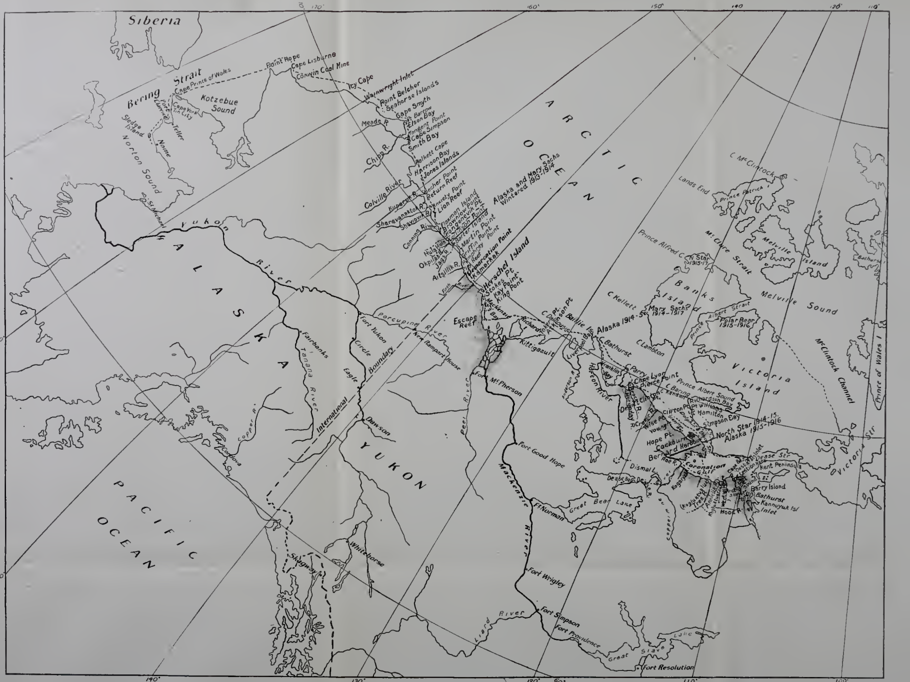
Full meteorological observations were kept up for three years, with barograph, thermograph; maximum, minimum, and standard thermometers; mercurial barometer, and anomometer. Tidal observations were taken for some time at Collinson point, Alaska; at Demarcation point, and at Bernard harbour, Dolphin and Union strait.

The Geological Survey, Department of Mines, is attending to the computing and plotting of the maps surveyed, in its Topographical Division, and the technical geological and ethnological reports in the Geological and Anthropological Divisions, respectively. Full reports of the various scientific activities of the members of the Southern division of the Canadian Arctic Expedition of 1913-16 are in course of preparation, and will be transmitted to the various departments as soon as completed.

I have the honour to be sir,
Your obedient servant,

RUDOLPH MARTIN ANDERSON,
Chief of the Southern Division of the
Canadian Arctic Expedition of 1913-1916.

Zoologist, The Geological Survey,
Ottawa.



WITH NUMEROUS ADDITIONS SKETCHED IN
ILLUSTRATING FIELD OF WORK OF SOUTHERN DIVISION
OF THE CANADIAN ARCTIC EXPEDITION OF 1913 1916

DOTTED LINES TRAVERSED BY SLED OR BOAT
BUT NOT PROPERLY SURVEYED

From map compiled by Topographic Division of the Geological Survey.

AREAS SHADED SURVEYED
AND CHARTED 10 MILES TO 1 INCH

21277

Report of George H. Wilkins on the Topographical and Geographical Work carried out by him in connection with the Canadian Arctic Expedition.

The Deputy Minister,
Department of the Naval Service,
Ottawa.

Sir,—I beg to report the following information on the Topographical and Geographical work carried out by me during my journeys in connection with the Canadian Arctic Expedition.

This report is mostly confined to observations made on Banks island and the vicinity for the other parts visited were either covered by the Topographers of the Expedition or by others of the party previous to my traverse.

In 1914, when proceeding in the *Mary Sachs* to meet Mr. Stefansson, we approached Banks island in a fog and the first sight of the coast that we obtained was in the vicinity of cape Lambton, which is a blunted point rising abruptly from the water to a height of fifty feet or more and shelving back about a hundred yards to rise again almost perpendicularly to almost 800 feet. The cliffs and mountains beyond were barren and rugged in appearance from the south; deeply scarred by ravines and studded here and there with boulders.

As we proceeded along the coast to the northwest we drew away from the higher cliffs and the mountains receded to undulating hills of a thousand feet or more in height. Numerous small but rapid streams had been noticed coursing through the ravines, and about fifteen miles northwest from the cape a fair-sized river enters the sea through a narrow valley. The source of this river is evidently in the mountains back of Nelson head, but for a mile or so along the coast it runs from west to east. Two ranges of hills extend parallel to the coast towards cape Kellett, intersected here and there by rivers cutting through them to the sea. We found Thesiger Bay to be more like two bays than one and we could not see cape Kellett until around a point some 17 miles from there.

The southwest coastline ends for the most part in cut-banks which are gradually washing away into the sea each summer, but here and there along the coast there are sandspits sheltering lagoon mouthed creeks or rivers. Once around the point in Thesiger bay one sees two islands not marked as yet on the Admiralty chart 2118, and a semi-circular sandspit reaching out towards them from the mainland. Behind the islands and the sandspit is good shelter for a boat of shallow draft, and we used a ten-foot channel close beside the sandspit to get into shelter.

Stretching inland from behind the islands is a narrow bay about two miles deep and it seems likely that there is a channel to get into this from the south side of the islands, but we had not time to sound these waters.

Cape Kellett is not at all like what one would expect from the chart. The sloping hills end much more abruptly and form a much less conspicuous hook, although a half-moon shaped sandspit does extend out in the nature indicated for three miles or so and half a mile in width. Behind this there is also shelter from a southwest and southeast wind, but from observation it seems that if there is ice about it will pack tightly on the cape and severely hamper any vessel trying to get out.

Another thing that makes this point very troublesome to navigate is the strong set of the current from north to southeast around the cape. It has

always had the same direction when I have had the opportunity to observe it, but we were unable to make sufficient observations to prove that this is always so.

From cape Kellett northward the land recedes to form a shallow bay as indicated on the map, and emptying into it is a broad but shallow river which has its source amongst the hills behind cape Lambton. Along this bay, and as a matter of fact the greater part of the western coast the beach is low and broken up by numerous lagoons whose waters lap the tundra at high tide. Long estuaries at intervals stretch in towards the rolling hills beyond. Following up the coast one comes to Worth point and from here on the place marked Haswell point long lagoons edged by sandspits border the land. Haswell point itself is really an island and both north and south of it another island will be noticed.

From Haswell point to Meek point the map is fairly accurate except that there is scarcely so deep a bight so close to the former; it is more in the middle distance. Terror island lies directly off Meek point and lies most east and west. For three miles past here the coast runs north of east but then turns south to form a bight in an inlet ten miles wide and fifteen or more deep which is not charted on the map. From Wolley point on towards cape Collins, lagoons are found most all the way, and from here onward the map is so incorrect that it is difficult to refer to it at all. Burnett bay does not exist but in its place is the low flat delta of a fair-sized river across the mouth of which lies an island, fifteen miles long and five hundred feet high at the highest point. Norway island is more off the place marked Pennell point and from here north the coast does not recede so much as one would think from off the shore for the hills beyond the flat land take the direction indicated on the chart.

Robilliard island seems about correct but from here onward in the direction of cape Alfred, a chain of islands extends all the way. There are but two Gore islands in the position indicated by the chart but the largest point of land at cape Prince Alfred is an island leaving a pointed sandspit for the cape. A conspicuous round topped hill can be noticed a mile or so south of the real cape. It is only fair to remark that when travelling from the north to the south from cape Alfred and some distance off-shore that the land has the appearance indicated by the chart. About twenty miles northeast along the coast from cape Alfred a low sandy island stretching across the mouth of a deep fiord would seem to make a good harbour for a boat. We had not time to sound this place but a few odd cakes of ice amongst the smooth would suggest a channel of at least twenty feet in depth.

About cape Clifford a river bed about two miles wide cuts through the hills from the high plateau behind and forms a break in the range which gradually increases in height from cape Alfred. About three miles further along another branch of the same river runs into the sea, making the intervening section practically an island. On the southwest branch of this river, and near the coast there is a beacon, but we could not find any trace of a record having been left.

Another few miles along the coast another small river enters the sea through steep-sided banks and on the banks of this river and about seven miles inland I found seams of coal. There is scarcely a distinctive point in the vicinity of cape Wrottesly, but just thereabouts there is a large lagoon, the outside barrier of which is a very low and inconspicuous sandspit. However the coast turns in a more easterly direction with a gradual change as far as cape McClure. Cape McClure is bold and precipitous and somewhat resembles cape Lambton in appearance. Here again the map is very deceptive for one cannot find a conspicuous point where cape Crozier is marked on the map, and although the coast turns almost south it does not make any westing but bends gradually towards cape Clifton, then some eight miles west of Providence point one finds a bay some three miles wide and ten miles deep, into the bottom of which empties a large river which Mr. Stefansson and his party followed in the summer of 1915 and will doubtless describe. I did not traverse the coast from Mercy

bay to John Russel point, but from this point to Milne point the coast line seems fairly accurate.

In general topography Banks island has the appearance of a high range of hills, whose peak is about 2,000 feet high and is within forty miles of Nelson head. The range runs from Nelson head to cape McClure ending abruptly at each end, with a high plateau in the centre of the island, but this a little lower than either end. On the western side it slopes gradually down towards the sea and the greatest watershed is in that direction. On the eastern side from Nelson head to Johnson bay the land slopes steeply down and the whole north-west corner is hilly. Numerous small lakes dot the landscape and several large ones ten miles long and two or more miles wide were found. One is eight miles inland directly opposite Armstrong point, and another a few miles north-west of that. Another is a few miles inland from Thesiger bay. We had no means of getting at their depths.

When following the Victoria land coast along the Prince of Wales straits one notices that Dean Dundas bay is not so deep by about five miles as it is mapped. Ramsay island would appear to be a good deal further south than it is marked, and the straits in this vicinity seem wider, but as we had no sextant with us we could not locate our positions accurately. The western coast of Victoria island is fairly low until one comes to Walker bay. From here mount Phayre is a very conspicuous round-topped hill. Cape Wollaston itself is low, but a high-cut bank a few miles east looms up noticeably. From Holman island one can see mount Arrowsmith, but not the island charted in the sound. This we found to be really two islands much more in the centre of the mouth of Prince Albert sound than charted. Cape Kendall is undoubtedly an island, and the high cliffs near point Williams are conspicuous. No sign was seen of Clerk island although we passed several times in that locality.

Ice Conditions.—The ice conditions met with on the *Karluk* during 1913 have no doubt been reported on.

The rivers had broken out by May 23, 1914, in the vicinity of point Barrow, but I was able to travel from that place by sled leaving on May 25—to Clarence lagoon in Canadian territory reaching the latter place on June 14. Travelling for the greater part of the distance at that time of the year was very uncomfortable owing to the waters of the rivers having flooded the smooth lagoon ice, and consequently forcing us to travel off shore over the rough pack ice. Even here the water had soaked under the crust of snow and on warm days one would repeatedly break through. On other occasions it was necessary to travel through the water which was often so deep that the dogs had to swim and the men push the sled.

The season at point Barrow in 1914 when we left was equally as much advanced as that at Collinson point when we arrived here on June 5th, but during the next few days at this place the snow disappeared very rapidly. At Clarence lagoon on the 14th most of the snow had disappeared from the ground, the water had melted holes in the ice and the solid ice had risen and was comparatively dry once more. Around the river mouths it was honey-combed and rotten, but off shore the travelling was fairly good. It was impossible to get on to lagoon ice or lakes at this time of the year in this vicinity for the fringe of open water round the edges, but we continued to travel on the sea ice until June 20th. The first general movement in the ice along the beach was on June 29th when it piled up on the sandspits to a height of twenty feet or more. The lagoon was clear of ice by July 6th and we were able to navigate the *Mary Sachs*. After several days of northeast wind the ice opened and scattered on the 18th, but it settled back again when the wind failed the next day. By the 23rd it had opened up again and we went out of the lagoon and proceeded to Herschel island having little difficulty with the ice.

One large steam whaler had reached the island from a little further down the coast some two days earlier, and another came in three days later. The Mackenzie river boats were late, however, and did not reach the island until August 7th, having been held up by pack ice to the eastward. Leaving Herschel island on the 4th we passed through scattered floes until we reached Richard island and here we were held up by the ice for two days. A westerly wind shifted it along the beach ahead of us and we reached the Baillie islands without much trouble with the ice. East of here the straights seemed packed with ice, but a few days of easterly wind cleared it out and we proceeded to Pierce point and across to Banks island in open water. Westerly winds had set in again by the time we reached this coast and had packed the ice in along the coast and in Thesiger bay. However as we neared cape Kellett on Aug. 26th, it appeared as though the ice had never left the beach in this vicinity. However one or two small rivers had melted out the ice to some extent and after a great deal of bucking and manœuvering we brought the schooner in beside the beach on Sept. 1st. Young ice had been forming each night for several nights and cementing the older floes together, and around cape Kellett and as far west as we could see, there was solid floe ice. To the south and away to the north we could see the streaks of water sky, but there were no means of reaching it.

On September 10th, during a storm, the ice cleared away from the beach leaving the southern and western coasts free for navigation. However the main pack ice never shifted far off the western coast, but remained off shore; while the sea froze over solid enough to travel on by the 21st. Cracks and open leads of water appeared to the south and west of cape Kellett at intervals during the winter, but the ice had little motion. Travelling along the whole west coast of Banks island one could see that there had been open water there during the fall, for there was little old ice near the beach. On the north coast from cape Alfred the ice was much broken up and we had evidence of much motion in the ice during the winter as far east as cape McClure.

During the months of February and March of both 1915 and 1916, and, as a matter of fact, at intervals all through the winter, there were leads of open water in the vicinity of cape Alfred. The general drift of the ice in this vicinity was towards the west, but the same floes that went out would sometimes drift back again. At cape Kellett by the 1st of May, 1915, the sandspits were bare of snow, but during the early part of May the snow on the inland slopes was hard and made a good surface for travelling over. In fact, the ice and snow conditions remained excellent for travelling over until we reached the Dolphin and Union straits on the 21st of May, en route from Kellett, Banks island to Bernard harbour. Along the coast from here and across the Coronation gulf to the mouth of the Coppermine river the travelling was good until the 1st of June.

The season seemed particularly late in that vicintiy in 1915 and on the 21st of June there were still three feet of snow in drifts around the tents and many patches on the land. It was the 20th of July before we could move the boat in the harbour and not until the 9th of August that we could proceed along the coast to Coronation gulf. We had some trouble in getting through the straits past Lambert island but once in the gulf we had clear water as far east as cape Barrow. Leaving cape Barrow on the 11th of August, we reached Baillie island on the 11th without having encountered any ice on the way. On the 16th we crossed the straits to cape Kellett in the *North Star* without trouble and found the Banks island southeast coast practically clear of ice. The heavy pack was never far from the western shore. Starting from cape Kellett on the 26th we proceeded north close to the beach, but it was only on account of the shallow draft of our vessel—4 feet, 6 inches—that we were able to pass between the heavy pack and the beach, as far as Norway island. At this place and further north the ice was still solid on the beach, and only moved out for a few miles

further for the next few days. By the 20th of August, we had reached just north of Robilliard island but further north than here the ice never left the beach in 1915.

A westerly wind drove the pack inshore along the coast as far as we could see and by the 10th of September we could walk anywhere across the frozen sea. It would seem that in only exceptionable years that a boat could proceed along the whole west coast of Banks island for the ice does not appear to move far off the shore, and the open season is so very short in any case. During 1916 I was able to travel from Armstrong point to Coronation gulf, leaving the former place on June 1st, and arriving at the latter on June 13th; but this was just about as late as one could have travelled that year, and even then we had to use a sled raft to cross a number of the tide cracks. Most of the way we travelled through six inches or more of pen water and across the Dolphin and Union straits the ice was very thin and rotten. 1916 was a very much earlier season in this vicinity than 1915, for we took a boat from the same position as the year before some four weeks earlier.

In 1914 Banks island was covered with snow for the winter on the 12th of September, although it had been snowed over and melted off a day or two before. In 1915 the ground was covered at cape Prince Alfred by the 8th of September.

Fuel on Banks island.—There is a little driftwood to be found on the east, west and south coasts of Banks island, but none at all, except a few chips, on the north coast. On any part there is scarcely enough to keep a big camp fire going for a twelve-month within a stretch of fifteen miles and more often not so much. During the summer there is an abundance of heather to be found on the inland slopes but very little willow. Wood is sometimes found many miles inland projecting from the banks of rivers and even on the hilltops, but this is not to be depended on for fuel. The coal deposits near the northern coasts may prove useful, judging from the samples taken, for they would burn well when lighted on a primus stove. We had no means of testing it in a camp stove. However, one is always well advised to carry fuel oil in strong containers when travelling about the island.

Game, Fish, etc.—Caribou may be found on Banks island at each season of the year, but they are comparatively scarce at all times and need a deal of hunting for. They are in their prime from September until the end of November, but are hardly worth killing during March, April, May and part of June. Their skins are not so satisfactory as those of the mainland caribou, or the domestic deer for clothes although they can be used.

Seals are fairly numerous near the shore of all the islands and can most always be obtained at Nelson head, cape Kellett and cape Alfred during the winter in the leads that form in the ice. In the spring they can be shot while on the ice asleep, but this is not by any means an easy matter for they are difficult to approach. In the summer they seem to float if they are killed quite dead, and the wound is not too large, but late in the fall they float more readily.

Polar bears are comparatively numerous along the coast, although their presence may have been due in the neighbourhood of cape Kellett to a stranded whale carcass. Along the north and south coasts the open leads of water no doubt keep them near the land, and many are found travelling along the Prince of Wales straits. The Eskimo hunt them each year in the vicinity of Nelson head, and during the early spring one man told me that he had followed a bear so far out on the ice that he had seen the land on the other side of the straits.

Ducks and white geese are very numerous around cape Kellett in the spring and may be on the other part of the island for all we know. During the summer the white geese especially can be driven about in flocks when they are moulting and killed like sheep. At this time of the year they are not so very fat and are much better if killed earlier in the season. Curiously enough from some 250 geese that were killed at cape Kellett during the summer of 1915, only one was found to be a female and only one egg was found during the season.

Ptarmigan are fairly numerous on the coasts in early spring, but not so plentiful as on the mainland. Many schools of fish were seen swimming in the water and the Eskimo tell us that they are plentiful in the large lakes on the island. We had a net set from a sandspit but only caught one fish. The women caught several dozen Tom-cod through the ice one fall, but we had not time to give the fishing much attention. On Victoria island the fish are very plentiful in lakes and the local Eskimo seem to catch a lot in spring and fall.

Clothing.—We found the native method of dressing with fur clothes next the skin to be most suitable for extensive travel, although when frequent changes can be had, woollen clothes are very comfortable. I also found a woollen mask that fitted closely to the face having two holes for the eyes and one for the mouth and nose, a great protection from the frosty wind. It is essential, however, that this garment should fit tightly to the face, and also that the edges of the openings are far enough away from the nose and mouth to prevent the breath melting the hoar frost which forms outside and making ice. Although I travelled at times under severe conditions I never had a frost bite on the face while using the woollen face-mask.

I found fur socks most serviceable and comfortable if a very thin woollen, sock was worn next to the feet, but the care of the feet in the Arctic is a personal equation differing with each individual. Polar bear skin or domestic sheepskin mittens are most satisfactory in comparatively warm weather, but in very cold weather we found nothing that was entirely satisfactory if one was going a long journey without the chance to dry one's clothes. Well-fitting dog or wolf skin, covered with canvas, are about the best.

Winter Travel along the west coast of Banks island.—It is quite possible to travel along the coast in winter, although the temperature might average —25 degrees F. or more, and the sun does not appear for two months. However, on the western coast of the island it is more difficult than in most places, for the land is so low-lying that by lantern light it is difficult to tell when one is wandering inland and the only means of knowing in most cases is by digging through the snow at frequent intervals to see if one is still on the sea ice.

Snow Houses.—We found the building of snow houses practicable from the middle of October to the middle of May, and much preferred to live in them than tents. Their greatest drawback is perhaps the length of time they take to build. A house 12 feet in diameter, big enough to accommodate seven people can scarcely be put in condition to live in, in less than two hours by four men. It more often takes three hours, depending on the quality of the snow with which one has to build. Once the principle is grasped it requires but little skill to build a house of snow, but quite a deal of art and skill are required to build a perfect dome-shaped one, which type is by far the best.

Dog Sickness.—Dog sickness of a kind peculiar to the Polar regions is always a worry to the Arctic traveller. It attacks the dogs most frequently in spring time, although we had one dog die of it in winter. The symptoms, though generally alike, differ with each individual attacked. Persistent mournful howling and a restlessness were usually the first symptoms noticed, and the dog would then gnaw anything which it could reach. This would be followed in a few hours by apparent paralysis of the muscles of the throat. While no inflammation was noticeable, it was impossible for the dog to swallow a morsel of food, even if it was placed in the mouth. The dog was evidently in great pain and could not rest. In two days their eyes would be glazed and sunken and the next day they would invariably die.

I am, sir, your obedient servant,

GEO. H. WILKINS,
Photographer.

ANNUAL REPORT OF THE RADIOTELEGRAPH BRANCH, 1916-17.

The Deputy Minister,
Department of the Naval Service,
Ottawa.

SIR,—I have the honour to present herewith the annual report of the Radiotelegraph Branch for the fiscal year ending the 31st March, 1917.

The total number of stations in operation in the Dominion and on ships registered therein is as follows:—

Government Commercial Stations	1
Coast Stations	42
Government Ship Stations	24
Licensed Ship Stations	76
Public Commercial Stations	3
Private Commercial Stations	3
Radiotelegraph Training Schools	2
Licensed Experimental Stations	5
Total	156

The following list shows the location of the land and coast stations in Canada, their range, call signals, owners and by whom they are operated:—

COAST STATIONS for Communication with Ships.

EAST COAST.

Name.	Where situated.	Owned by.	Operated by.	Range in nautical miles.	Call Signal.
Belle Isle, Nfld.	Belle Isle Straits	Dominion Government.	Marconi Wireless Tel. Co. of Canada.	250	VCM
Pt. Amour, Nfld.	" "	"	"	150	VCL
Pt. Riche, Nfld.	Gulf of St. Lawrence	"	"	250	VCH
Harrington, P.Q.	"	"	"	150	VCJ
Heath Pt., P.Q.	Gulf of St. Lawrence (Anticosti Isld.)	"	"	250	VCI
Cape Ray, Nfld.	Cabot Straits	"	"	350	VCR
Cape Race, Nfld.	North Atlantic	"	"	400	VCE
Grindstone Island, P.Q.	Gulf of St. Lawrence (Magdalen Isld.)	"	"	200	VCN
Fame Pt., P.Q.	Gulf of St. Lawrence	"	"	250	VCG
Clarke City, P.Q.	"	"	"	250	VCK
Father Pt., P.Q.	River St. Lawrence.	"	"	250	VCF
Grosse Isle, P.Q.	"	"	"	100	VCD
Quebec, P.Q.	"	"	"	150	VCC
Three Rivers, P.Q.	"		"	150	VCB
Montreal, P.Q.	"	"	"	200	VCA
Cape Sable, N.S.	North Atlantic	"	"	250	VCU
Partridge Isld., St. John, N.B.	Entrance St. John Harbour, N.B.	"	"	250	VCV
Cape Bear, P.E.I.	Northumberland Strait.	"	"	150	VCP
Camperdown, N.S.	Entrance to Halifax Harbour.	"	"	250	VCS
Sable Island, N.S.	North Atlantic	"	"	300	VCT
Halifax, N.S.	Halifax Dockyard.	"	Department of the Naval Service.	100	VAA
Pictou, N.S.	Northumberland Strait.	Marconi Wireless Tel. Co. of Canada.	Marconi Wireless Tel. Co. of Canada.	100	VCQ
North Sydney, C.B.	North Sydney, C.B.	Dominion Government.		100	VCO

Coast Stations for Communication with Ships—*Concluded.*

GREAT LAKES.

Name.	Where Situated.	Owned by.	Operated by.	Range in nautical miles.	Call Signal.
Port Arthur, Ont....	Port Arthur, Ont.... ..	Dominion Government.	Marconi Wireless Tel. Co. of Canada...	350	VBA
Sault Ste. Marie, Ont..	Sault Ste. Marie, Ont.	"	"	350	VBB
Tobermory, Ont.	Entrance Georgian Bay.	"	"	350	VBD
Midland, Ont..	Georgian Bay..	"	"	350	VBC
Point Edward, Ont.	Lake Huron....	"	"	350	VBE
Port Burwell, Ont....	Lake Erie....	"	"	350	VBF
Toronto, Ont....	Toronto Island, Ont...	"	"	350	VBG
Kingston, Ont..	Barriefield Common..	"	"	350	VBH

WEST COAST.

Gonzales Hill, B.C. (Victoria).	Victoria, B.C..	Dominion Government.	Department of the Naval Service.	250	VAK
Pt. Grey, B.C. (Vancouver)..	Entrance Vancouver Harbour.	"	"	150	VAB
Cape Lazo, B.C..	Strait Georgia, near Comox, B.C.	"	"	350	VAC
Pachena Pt., B.C....	West Coast Vancouver Isld.	"	"	500	VAD
Estevan Pt., B.C..	" "	"	"	500	VAE
Triangle Isld, B.C....	South of Hecate Str...	"	"	450	VAG
Ikeda Head, B.C.	South of Moresby Island Q.C.I.	"	"	250	VAI
Dead Tree Pt., B.C...	South of Graham Isld., Q.C.I.	"	"	200	VAH
Digby Island, B.C., Prince Rupert.	Digby Isld., Entrance Prince Rupert Har.	"	"	250	VAJ
Alert Bay, B.C...	Cormorant Isld., B.C.	"	"	350	VAF

HUDSON BAY.

Port Nelson....	Hudson Bay.	Dominion Government.	Department of the Naval Service.	750	VBN

LAND STATIONS.

Le Pas, Man.	For communication with Port Nelson only.	Dominion Government.	Department of the Naval Service.	750	VBM

Licensed Commercial Stations.

Name.	Where Situated.	Owned by.	Operated by.	Range in nautical miles.	Call Signal.
Public Commercial.					
Glace Bay, C.B.	Near Glace Bay, C.B.	Marconi Wireless Tel. Co. of Can., Ltd	Owners	3,000	GB.
Louisburg, C.B.	Cape Breton	"	"	Reception only	
Newcastle, N.B.	New Brunswick	Universal Radio Synd.	"	2,500	CL
Private Commercial.					
Ocean Falls, B.C.	Ocean Falls, B.C.	Ocean Falls	Owners	150	CD
Powell River, B.C.	Powell River, B.C.	Powell River Co.	"	30	CH
Granby Bay	Granby Bay	Granby Con. S. M. & P. Co.	"	150	CZ

Name.	Where Situated.	Owned by.	Call Signal.
Marconi Test Room	Rodney St., Montreal	Marconi Wireless Telegraph Co. of Canada, Ltd.	XWA
R. M.C . Kingston	Kingston, Ont.	R. M. C. Kingston	XWC
Barriefield Camp	Barriefield, Ont.	D. S. O., 3rd M. D.	XWD
Niagara Camp.	Niagara, Ont	D.S.O., 2nd M.D.	XWE
Camp Borden	Camp Borden, Ont.	D.S.O., 2nd M.D.	XWF

Radiotelegraph Training Schools.

Name.	Where Situated.	Call Signal.
Dominion Telegraph & Wireless Institute	Vancouver, B.C.	Licensed for reception only.
Columbia College of Wireless	Victoria, B.C.	

Amateur Radiotelegraph Stations.

All amateur stations were closed down at the outbreak of hostilities.

Licensed Ship Stations.

The following list shows the vessels of Canadian register which are equipped with radiotelegraph apparatus, their call signal and by whom they are owned and operated:—

Name of Ship.	Port of Registry.	Name of Owners.	Name of Company operating the Station.	Call Signal.
SS. Assiniboia	Montreal, P.Q	Can. Pacific Railway	Marconi Wireless Tel. Co. of Can.	VGI
" Alberta	"	"	"	VFQ
" Athabaska	"	"	"	VGG
" Manitoba	"	"	"	VGH
" Keewatin	"	"	"	VGC
" Boston	Yarmouth, N.S.	"	"	VFS
" Hamonic	Collingwood, Ont.	Northern Nav. Co.	"	VGD
" Huronic	"	"	"	VGE
" Province	Port Arthur, Ont.	Great Lakes Towing and wrecking Company	"	VFR
" Empire	"	"	"	VFP
" Salvor	Victoria, B.C.	B.C. Salvage Co.	Owners	VFV
" Prince Albert	Prince Rupert, B.C.	Grand Trunk Pac Ry.	"	VFL
" Prince John	"	"	"	VFM
" Florence	Toronto, Ont.	T. Eaton	"	VFT
" Princess Beatrice	Victoria, B.C.	Can. Pacific Railway	M. W. T. Co. of C.	VFC
" Princess Charlotte	"	"	"	VFE
" Princess May	Vancouver, B.C.	"	"	VFH
" Princess Royal	Victoria, B.C.	"	"	VFG
" Tees	"	"	"	VFK
" Camosun	Vancouver, B.C.	Union Steamship Co.	Owners	VFZ
" Princess Adelaide	Victoria, B.C.	Can. Pacific Railway	Marconi Wireless Tel. Co. of Canada.	VFA
" Princess Mary	"	"	"	VFB
" Princess Alice	"	"	"	VFD
" Princess Ena	"	"	"	VFJ
" Princess Sophia	"	"	"	VFI
" Lord Strathcona	Quebec, P.Q.	Quebec Salvage Co.	"	VFX
" Royal George	Toronto, Ont.	Canadian Northern SS	"	VGA
" Chelohsin	Vancouver, B.C.	Union Steamship Co.	Owners	VGN
" Prince Arthur	Yarmouth, N.S.	Boston and Yarmouth SS. Co.	Marconi Wireless Tel. Co. of Canada.	VGJ
" Prince George	"	"	"	VGK
" Halifax	Halifax, N.S.	C. A. Plant SS. Co.	"	VGP
" Douglas H. Thomas	Sydney, C.B.	Dom. Coal Co.	"	VGR
" Princess Maquinna	Victoria, B.C.	Can. Pacific Railway	"	VGT
Car Ferry "Ontario No. 1"	Montreal, P.Q	Ont. Car. Ferry Co.	Owners	VGU
SS. Noronic	Port Arthur, Ont.	Northern Nav. Co.	Marconi Wireless Tel. Co. of Canada	VGW
" Seal	Windsor, N.S.	Halifax Trading and Sealing Co.	"	VGV
" Deliverance	Liverpool, N.S.	Southern Salvage Co	M. W. T. Co.	VFO
" Bessie Dollar	Victoria, B.C.	Dollar SS. Lines	Owners	VFF
" Venture	Vancouver, B.C.	Union SS. Co.	"	VGX
" Yarmouth	Yarmouth, N.S.	C.P.R.	M. W. T. Co.	VGY
" Princess Patricia	Victoria, B.C.	"	Owners	VGZ
SS. Dalhousie City	Toronto, Ont.	N. St. C. & T. N. Co.	M. W. T. Co.	VEA
" Corona	"	C. SS. Lines	"	VEB
" Kingston	"	"	"	VEC
" Toronto	"	"	"	VED
" Hazel Dollar	Victoria, B.C.	Dollar SS. Lines	"	VEE
" Chippewa	Toronto, Ont.	"	"	VEH
SS. Garden City	Toronto, Ont.	N. St. C. & T. N. Co.	M. W. T. Co.	VEI
" Chicora	Halifax, N.S.	C. SS. Lines	"	VEJ
" Macassa	Hamilton, Ont.	"	"	VEK
" Cayuga	Toronto, Ont.	"	"	VEL
" Cascapedia	Quebec, P.Q.	"	"	VEO
Tug "Harrison"	Owen Sound, Ont.	J. Harrison & Sons.	"	VFY
Car Ferry "Ontario No. 2"	Montreal, P.Q.	Ont. Car. Ferry Co.	Owners	VER
SS. Imperoyal	Sarnia, Ont.	Inperial Oil Co.	M. W. T. Co.	VGM
" Armonia	Montreal, P.Q	R. Lawrence Smith	"	VES

Licensed Ship Stations—*Concluded.*

Name of Ship.	Port of Registry.	Name of Owners.	Name of Company operating the Station.	Call Signal.
SS. Turret Crown....	Newcastle, G.B..	Coastwise SS. & Barge Co....	Owners...	ZDH
" Luzblanea..	Toronto, Ont..	Imp. Oil Co.....	M. W. T. Co..	VEU
SY. Aquilo...	Vancouver, B.C..	B. D. Rogers...	Owners...	VFU
SS. Sable I..	Windsor, N.S.	J. A. Farquahar....	M. W. T. Co..	MTZ
SS. G. R. Crowe..	Toronto, Ont..	G. R. Crowe SS. Co.	"	VET
Tug Pilot...	Victoria, B.C.	B. C. Salvage Co.	Owners.....	VEV
SS. Glenshee	Midland, Ont..	Gt. Lakes Transp. Co	M. W. T. Co....	VEW
" Charlton	Windsor, Ont.	Vietoria Harbour Lumber Co..	"	VEX
" Reginald..	Sarnia, Ont..	"	"	VEY
" Freshfield..	Montreal, P.Q	R. Lawrence Smith Co...	"	VEZ
SS. Harold Dollar...	Victoria, B.C.	Dollar SS. Lines..	M. W. T. Co..	VCY
" James Reid....	Sarnia, Ont..	Reid wrecking Co....	"	VCZ
" Schoolcraft..	Midland, Ont	Manley Chew...	"	VAU
" Manxman...	Montreal, P.Q..	R. Lawrence Smith Co...	"	GDZ
" Sellasia...	St. John, N.B...	W. Thompson & Co..	Dept. Naval Service..	ZIR
" Royalite	Sarnia, Ont	Inperial Oil Co..	M. W. T. Co.....	VBQ
" Sarnolite	"	"	"	VBR
" Iocolite...	"	"	"	VBS
" Mina Brea.	Toronto, Ont.....	Inth Petroleum Co.	Owners.....	VAP
" Njord.....	Sydney, N.S..	Murray & Crawford Line.	M. W. T. Co..	VAO

Government Steamers Equipped with Radiotelegraph Installations. Operated by the Department of the Naval Service.

Name.	Range.	Call Signal.
H.M.C.S. *Niobe*.	400 miles	VDA
" *Rainbow*...	250 "	VDB
C. G. S. *Canada*.....	150 "	VDC
" *Acadia*.....	200 "	VDT
" *Malaspina*...	200 "	VDU
" *Galiano*.	200 "	VDV

Operated by the Department of Marine and Fisheries.

Name.	Range.	Call Signal.
C. G. S. *Stanley*...	150 miles.	VDE
" *Lady Laurier*..	150 "	VDF
" *Aberdeen*.....	100 "	VDG
" *Druid*...	100 "	VDH
" *Montcalm*..	150 "	VDJ
" *Lady Grey*...	100 "	VDL
" *Quadra*...	100 "	VDM
" *Estevan*..	200 "	VDN
" *Dollard*.	150 "	VDO
" *Newington*	100 "	VDP
" *Lurcher Lightship*..	100 "	VDR
" *Simcoe*...	100 "	VDS
" *Aranmore*...	200 "	VDQ
" *Prince Edward Island*..	100 "	VBY

Operated by the Department of Railways and Canals.

Name.	Range.	Call Signal.
C. G. S. *Durley Chine.*	200 miles.	VDQ
" *Sheba.*	200 "	VDZ

Operated by the Post Office Department.

Name.	Range.	Call Signal.
C. G. S., *Lady Evelyn.*	100 miles.	VDX

Operated by the Customs Department.

Name.	Range.	Call Signal.
C. G. S. *Margaret.*	200 miles.	VDW

Operation of the Coast Station Services.

The coast station services have been maintained on a war basis throughout the year. The amount of business handled by the east coast system shows a decrease from last year's business, amounting to 7,360 messages, containing 159,551 words.

The great lakes system (operated by the Marconi Wireless Telegraph Company of Canada, Limited, under contract) shows an increase of 2,904 messages containing 52,434 words.

The west coast system (operated directly by this department) shows an increase of 26,072 messages, containing 629,025 words.

The Hudson Bay system (operated for the department of the Railways and Canals by this department) shows a decrease of 1,353 messages containing 178,127 words.

Table No. 1 shows a comparative statement of the business handled by the different systems during the past seven years.

TABLE No. 1.—Comparative Statement of Business handled by the Radiotelegraph Systems during the last seven years.

Service.	1910-11.		1911-12.		1912-13.		1913-14.		1914-15.		1915-16.		1916-17.		Comparison with 1915-16.		
	Messages.	Words.	Messages.	Words.	Messages.	Words.	Messages.	Words.	Messages.	Words.	Messages.	Words.	Messages.	Words.	Increase or Decrease.	Messages.	Words.
East Coast	71,594	1,179,434	119,049	1,824,450	153,843	2,704,411	145,605	2,443,145	59,846	1,196,512	45,195	864,020	37,835	704,469	Decrease	7,360	159,551
Great Lakes	Nil.		1,043	17,095	2,750	52,422	9,601	219,786	15,785	326,505	13,617	259,366	16,521	311,800	Increase	2,904	52,434
West Coast	48,074	647,461	76,158	997,900	115,494	1,518,926	157,354	2,206,331	98,386	1,532,526	95,048	1,103,395	121,120	1,732,420	Increase	26,072	629,025
Hudson Bay									5,259	325,961	7,617	570,281	6,264	392,154	Decrease	1,353	178,127
Totals	119,668	1,826,895	196,250	2,839,445	272,087	4,275,759	312,560	4,869,262	179,276	3,381,504	161,477	2,797,062	181,740	3,140,843	Net Inc.	20,263	343,781

REVENUE.

The total revenue collected during the year amounted to $16,731.33 against $8,494.99 in 1915-16.

The west coast service shows an increase of $8,241.26, the Great Lakes an increase of $29.74 and the East Coast a decrease of $34.66.

TABLE No. 2.—Shows a comparative statement of revenue received by the Coast Station services during the past eight years.

	1909–10	1910–11.	1911–12	1912–13.	1913–14.	1914–15.	1915–16.	1916–17.
	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.
East Coast.	Nil.	Nil.	229 57	475 00	318 42	322 99	1,022 33	987 67
Great Lakes	Nil.	Nil.	Nil.	17 08	27 55	85 92	78 16	107 90
West Coast..	Nil.	3,108 63	4,484,77	9,928 40	15,992 70	11,329 44	7,394 50	15,635 76
Totals	Nil.	3,108 63	4,714 34	10,420 48	16,338 67	11,738 35	8,494 99	16,731 33

EXAMINATION FOR CERTIFICATE OF PROFICIENCY IN RADIOTELEGRAPHY.

135 operators were examined during the year, including 8 re-examinations. 64 candidates were successful and 71 failed.

The following list shows the names of the successful candidates for Certificate of Proficiency in Radiotelegraphy:—

Number of Certificate.	Date of Certificate.	Name.	Grade of Certificate.	Where Examination held.
142.	April 3rd 1916	Wood, E.	1st Class Ship.	Halifax, N.S.
143.	May 9th 1916	Tricker, Wm.	1st "	Victoria, B.C.
144.	April 13th 1916	Wood, L. P.	1st "	Halifax, N.S.
145.	" 29th 1916	Baird, A. M	1st "	Vancouver, B.C.
146.	May 25th 1916	Maggs, S. A.	1st "	Halifax, N.S.
147.	" 2nd 1916	Rogers, B. D.	2nd "	Victoria, B.C.
148.	" 6th 1916	Atkins, J. L.	1st "	Victoria, B.C.
149.	June 16th 1916	Hooper, W. A.	1st "	Victoria, B.C.
150.	" 28th 1916	Rosebrugh, D. W.	1st "	Halifax, N.S.
151.	" 16th 1916	Shephard, L. A.	1st "	Vancouver, B.C.
152.	" 16th 1916	Webster, C. R	1st "	Vancouver, B.C.
153.	" 16th 1916	Hardy, D. J.	1st "	Vancouver, B.C.
154.	July 13th 1916	Gulland, F. M.	1st "	Victoria, B.C.
155.	" 13th 1916	Stobart, T. P.	1st "	Victoria, B.C.
156.	" 13th 1196	Cooper, J. K.	1st "	Victoria, B.C.
157.	25th 1916	Twinn, B. L.	1st "	Halifax, N.S.
158.	Sept. 21st 1916	Pottle, W. R.	1st "	Halifax, N.S.
159.	" 25th 1916	McLean, S. A.	1st "	Halifax, N.S.
160.	" 9th 1916	Arundel, B.	1st "	Vancouver, B.C.
161.	" 22nd 1916	Scott, R. B. Y.	1st "	Toronto, Ont.
162.	" 22nd 1916	Shepherd, R. A.	1st "	Toronto, Ont.
163.	" 14th 1916	Rennie, R. F.	1st Class Coast.	Tobermory, Ont.
164.	" 13th 1916	Tetley, W. J.	1st "	Tobermory, Ont.
165.	Oct. 2nd 1916.	Paint, O. F.	1st Class Ship.	Victoria, B.C.
166.	" 16th 1916	McWilliams, J. R.	1st "	Victoria, B.C.
167.	Sept. 22nd 1916.	Price, A. V.	1st "	Toronto, Ont.
168.	Jan. 16th 1917.	McClure, J. S.	1st "	Victoria, B.C.

Number of Certificate.	Date of Certificate.	Name.	Grade of Certificate.	Where Examination held.
169..	Nov. 20th 1916	Begin, J. G. O..	1st Class Ship	Ottawa, Ont.
170..	Aug. 24th 1916.	Bround, E. M...	1st "	Halifax, N. S.
171..	Nov. 20th 1916	Allen, R. O.	1st "	Halifax, N.S.
172..	" 20th 1916	Bennett, E. G.....	1st "	Halifax, N.S.
173..	" 28th 1916	Greenhill, D. C...	1st "	Ottawa, Ont.
174..	" 16th 1916	Harris, C. K....	1st "	Vancouver, B.C.
175.....	" 28th 1916.	Smith, H. E. ..	1st "	Ottawa, Ont.
176...	" 29th 1916.	Edwards, G. A	1st "	Halifax, N.S.
177..	Jan. 5th 1917	Bent, R. A..	1st "	Halifax, N.S.
178...	" 10th 1917.	Moulton, W. S	1st "	Halifax, N.S.
179..	" 22nd 1917	McKenzie, H. B	1st "	Halifax, N.S.
180..	" 24th 1917	Peter, A. G..	1st "	Halifax, N. S.
181..	" 23rd 1917	Roberts, Stanley..	1st "	Halifax, N.S.
182....	" 16th 1917	Walsh, H. E.	1st Class Coast	Halifax, N.S.
183..	" 29th 1917	Macken, M. H	1st Class Ship...	Halifax, N.S.
184..	Feb. 3rd 1917.	Woodhead, C. F..	1st "	Halifax, N.S.
185..	Jan. 31st 1917.	McGrady, H. G.	1st "	Vancouver, B.C.
186..	Feb. 7th 1917	Rycroft, H.	1st "	Halifax, N.S.
187...	" 7th 1917	Pape, O. J	1st "	Halifax, N.S.
188..	Jan. 30th 1917	Berry, T. V...	1st "	Vancouver, B.C.
189..	Feb. 8th 1917	Allen, H. D...	2nd "	Victoria, B.C.
190..	Jan. 24th 1917	Westland, H. L. G..	1st "	Halifax, N.S.
191..	Feb. 12th 1917.	Heath, C. G. .	1st "	Halifax, N.S.
192...	" 7th 1917	Dennett, J. H...	1st "	Halifax, N.S.
193..	" 19th 1917	Moore, W. J. E..	1st Class Coast.	Halifax, N. S.
194..	" 21st 1917	Wallace, J. M.	1st Class Ship...	Halifax, N.S.
195.	Mar. 2nd 1917	Harris, A. K. W	1st "	Victoria, B.C.
196..	" 14th 1917	Bishop, P..	1st "	Halifax, N.S.
197.	" 19th 1917	Filtness, A. W	1st "	Vancouver, B.C.
198.	" 30th 1917	Ellison, J. H.	1st "	Ottawa, Ont.
199.	April 3rd 1917	Moor, H. H...	1st "	Ottawa, Ont.
200..	Mar. 19th 1917	Hodgson, E...	2nd "	Vancouver, B.C.
201. .	" 19th 1917.	Young, C. W..	1st "	Vancouver, B.C.
202...	" 19th 1917.	Robinson, D. M...	1st "	Vancouver, B.C.
203...	" 19th 1917	Spowart, A. A.	2nd "	Vancouver, B.C.
204..	" 7th 1917	Holmes, J. A	1st Class Coast	Halifax, N.S.
205.....	Jan. 12th 1917	Green, A. A..	1st Class Ship...	Victoria, B.C.

The following holders of certificates of proficiency in radiotelegraphy passed a successful examination in the operation of other equipments and have had their original certificates amended accordingly.

No. of Certificate.	Name.	Additional Equipment.
58	Emmerson, R G..	½ K.W., 1½ K.W. and 5 K.W Ship Stations.
13..	Lemieux, J. E. O..	5½ K.W. Coast Station.
193...	Moore, W. J. E...	1·7 K.W. Ship Station.
90 .	Taylor, Fred....	5½ K.W. Coast Station.
10..	Argue, A. E...	10 K.W. Coast Station.
76.	Hayman, E. D	10 K.W. Coast Station.
80..	Spracklin, C. R...	10 K.W. Coast Station.

TABLE No. 3.—Detailed Statement of Business handled by the ten stations on the West Coast operated by this Department.

Name of Station.	Private Business to and from Ships.		Private Business between Stations.		Business to and from Government Ships.		Government business between Stations.		Service Messages.		Retransmitted Messages.		Cost of Maintenance.	Revenue.
	Messages.	Words.	Messages.	Words.	Messages.	Words.	Messages.	Words.	Messages.	Words.	Messages.	Words.	$ cts.	$ cts.
Gonzales Hill (Victoria)	1,410	21,476	8,245	130,774	473	20,580	7,155	113,682	17,703	187,025	1,142	10,863	5,047 58	3,398 03
Pachena Point	266	3,764	19	220	131	6,542	436	1,666	2,105	17,874	229	4,728	3,014 98	127 20
Estevan Point	2,674	36,381	38	543	93	3,236	438	2,278	3,956	32,073	1,696	26,895	5,105 35	1,635 53
Dead Tree Point	6	53	1,768	47,789	15	669	9	199	2,153	16,579			1,876 40	547 03
Ikeda Head	28	388	550	9,325	20	844	13	250	1,736	11,354	88	1,633	1,294 51	355 96
Triangle Island	1,599	23,264	3,703	78,493	130	5,952	797	5,501	6,249	62,279	9,709	12,364	3,525 88	3,538 42
Point Grey	902	13,315	2,747	101,426	56	1,491	394	1,296	4,443	92,880	445	2,310	4,227 90	2,358 49
Digby Island (Pr. Rupert)	1,220	17,201	6,819	114,141	275	11,178	1,397	14,734	3,367	31,332	2	48	5,062 85	2,613 44
Cape Lazo	792	12,243	52	888	190	8,637	377	942	2,594	24,261	74	1,045	4,517 94	589 56
Alert Bay	436	6,349	392	5,397	45	1,999	29	403	2,065	17,839	5	187	4,092 86	472 10
District Office at Victoria													5,943 19	
General Account (including charter of steamers) Esquimalt Workshop, etc.													5,623 49	
Totals	9,333	134,434	24,333	488,996	1,428	61,128	11,045	140,951	46,371	493,496	28,610	413,415	51,332 93	15,635 76

Total number of messages handled		1,211 20
Total number of words handled		17,324 20
Total cost of maintenance of stations (including office workshop, etc)	$	51,332 93
Total Revenue		15,635 76

TABLE No. 4.—Detailed Statement of Business handled by the Eight Stations on the Great Lakes, owned by the Department of the Naval Service, and operated by the Marconi Wireless Telegraph Company of Canada, Limited.

Name of Station.	Private Business to and from Ships.		Private Business between Stations.		Business to and from Government Ships.		Government business between Stations.		Service Messages.		Retransmitted Messages.		Cost of Maintenance.	Government percentage of Revenue.
	Messages.	Words.	Messages.	Words.	Messages.	Words.	Messages.	Words.	Messages.	Words.	Messages.	Words.		
													$ ets.	$ ets.
Port Arthur	1,018	17,095	112	1,876	226	4,979	2	60	200	2,190	97	2,034	3,500 00	18 05
Sault Ste. Marie	1,745	33,207	57	640	406	11,857	4	121	138	3,770	1,007	20,075	3,500 00	27 52
Tobermory	12	313	162	2,932	219	6,338	25	278	574	4,718	987	19,017	3,500 00	4 56
Midland	911	15,193	89	1,852	277	8,850	6	134	231	3,617	706	12,812	3,500 24	9 60
Point Edward	1,059	17,786	316	6,688	37	1,130	1	60	817	11,661	957	23,238	3,540 00	28 57
Port Burwell	512	6,283	14	218	152	2,986			77	1,862	35	787	3,501 33	8 28
Toronto	733	11,174	143	3,103	10	238	15	327	2,361	48,416	71	1,885	3,500 00	11 32
Kingston													3,503 09	
Totals	5,990	101,051	893	17,309	1,327	36,378	53	980	4,398	76,234	3,860	79,848	28,044 66	107 90

Total number of messages handled	16,521
Total number of words handled	311,800
Total cost of maintenance	$ 28,044 66
Total revenue	107 90

TABLE No. 5.—Detailed Statement of Business handled by the Twenty-one Stations in the Gulf and River St. Lawrence and East Coast owned by this Department partly operated by the Department and partly operated by the Marconi Wireless Telegraph Co., of Canada, Limited, under contract.

Name of Station.	Private Business to and from Ships.		Private Business between Stations.		Business to and from Government Ships.		Government business between Stations.		Service Messages.		Retransmitted Messages.		Cost of Maintenance.	Government percentage of Revenue.
	Messages.	Words.	Messages.	Words.	Messages.	Words.	Messages.	Words.	Messages.	Words.	Messages.	Words.		
													$ cts.	$ cts.
Cape Sable													2,619 02	
Partridge Island (St. John, N.B.)	298	4,748			555	12,463	197	3,183	7	136	5	67	3,514 15	
Cape Race	5,498	83,328	5	112	1,286	20,879	17	280	313	4,110	437	7,069	3,500 00	
Grindstone Island	34	575	804	19,945	82	1,585	69	835	82	1,788	589	8,211	1,497 86	362 84
Cape Bear	4	98	21	631	225	4,454	47	510	41	619	795	30,940	2,500 00	
Point Riche			1	45	40	591	145	2,532	15	134	354	5,602	3,816 74	
*Point Amour	5	77	511	7,924	91	1,904	23	486	118	2,926	472	6,963	3,500 00	
†Belle Isle	2	67	139	2,620	141	4,517	496	4,184	127	3,606	3,893	79,586	4,500 00	
Cape Ray	578	8,788	125	1,806	194	3,542	28	410	185	3,827	190	3,183	3,500 00	
Harrington													2,500 00	
Heath Point	35	920	78	1,873	100	1,694	162	3,948	126	2,451	3,282	58,998	3,500 00	
Fame Point	464	10,812	468	10,169	367	7,832	126	3,006	795	836	14	251	3,500 00	
Clarke City													3,500 00	
Father Point	295	5,681			266	6,669			17	236	13	260	3,500 00	
Grosse Isle			10	128	407	5,767	376	5,980	21	485	179	4,348	2,500 00	
Quebec	278	4,687	5	79	752	16,795	532	13,595	127	2,777	85	1,617	2,500 00	
Three Rivers	9	144	3	46	238	5,635			30	561	432	8,473	3,500 00	
Montreal	341	6,122	2	19	82	1,961	1	11	150	3,321	12	182	3,500 00	
Sable Island			1	33	87	1,811	1,164	15,709	207	2,654	452	7,686	4,521 01	107 67
Camperdown (Halifax)	182	3,038	1	9	790	12,725	1,023	14,232	260	3,466			5,441 38	293 50
North Sydney	214	3,138			2,018	37,967	678	11,235	51	579	40	582	3,261 01	223 66
Totals	8,237	132,223	2,174	45,439	7,721	148,791	5,084	80,136	2,672	47,512	11,244	224,018	70,673 17	987 67

Total number of messages handled	37,132
Total number of words handled	678,119
Total cost of maintenance	70,673 17
Total Revenue	987 67

*Includes returns from 1st April 1916 to 31st December, 1916.
†Includes returns from 1st April 1916 to 10th November, 1916.

TABLE No. 6.—Detailed Statement of Business handled by the One station on the East Coast owned and operated by the Marconi Wireless Telegraph Company of Canada, Limited, under contract with the Department of the Naval Service.

Name of Station.	Private Business to and from Ships.		Private Business between Stations.		Business to and from Government Ships.		Government business between Stations.		Service Messages.		Retransmitted Messages.		Cost of Maintenance.	Revenue.
	Messages.	Words.	Messages.	Words.	Messages.	Words.	Messages.	Words.	Messages.	Words.	Messages.	Words.		
													$ cts.	$ cts.
Pictou	89	2,469	221	16,262	177	3,975	16	389	128	2,035	72	1,220	1,750 00	

Total number of messages handled	703
Total number of words handled	26,350
Total cost of maintenance	$ 1,750 00
Total revenue	

TABLE No. 7.—Detailed Statement of Business handled by LePas and Port Nelson Radiotelegraph Stations owned by the Department of Railways and Canals.

Name of Station.	Private Business to and from Ships.		Private Business between Stations.		Business to and from Government Ships.		Government business between Stations.		Service Messages.		Retransmitted Messages.	
	Messages.	Words.	Messages.	Words.	Messages.	Words.	Messages.	Words.	Messages.	Words.	Messages.	Words.
LePas	28	552	616	11,991	7	71	1,772	156,996	607	18,514		
Port Nelson	31	984	616	11,991	207	15,531	1,772	156,996	608	18,528		
Totals	59	1,536	1,232	23,982	214	15,602	3,544	313,992	1,215	37,042		

Total number of messages handled	6,264
Total number of words handled	392,154

The cost of maintenance of these stations is borne by the Department of Railways and Canals and all revenue collected accrues to that Department.

ASSISTANCE RENDERED TO SHIPS DURING THE YEAR BY THE GOVERNMENT RADIO-TELEGRAPH SERVICE.

West Coast.

SS. *Orion.*—On the 20th June, 1916, Tofino reported by telephone to the Estevan station that the captain of the ss. *Orion* had landed there and reported that his vessel was disabled with a broken shaft eight miles west of Lennard island, and required the assistance of the U.S. Government tug *Snohomish* immediately. Cape Flattery was at once advised by wireless of the accident. The *Snohomish* proceeded to the assistance of the disabled boat and took her in tow.

SS. *Northwestern.*—On the 17th July, 1916, the ss. *Northwestern* advised the Digby Island station, by wireless, that she had propellor trouble, several blades having shaken off and that she was proceeding south. The tug *Samson* joined the ss. *Northwestern* later and stood by her on the remainder of her trip south. Constant wireless communication was maintained with both ships.

SS. *Redondo.*—On the 19th August, 1916, the ss. *Redondo* broke her rudder stock, off Maud Island, Discovery passage, and was compelled to anchor off that island and await assistance. Wireless communication was immediately established with the ss. *Redondo* by the Cape Lazo station. The owners were advised of the vessel's condition and they despatched a tug boat which towed the *Redondo* to Seattle.

SS. *Princess Maquinna.*—On the 30th August, 1916, distress signals were received at the Point Grey station from the ss. *Princess Maquinna*, the vessel having run ashore during fog near Small island on her way to Vancouver. The *Princess Maquinna* eventually backed off and proceeded to Vancouver escorted by the ss. *Princess Alice.*

SS. *Kunajiri Maru.*—On the 23rd September, 1916, the ss. *Kunajiri Maru* ran ashore in a thick fog near New Dungeness lighthouse. The Gonzales Hill station was requested to arrange for a tug and was informed by the Seattle station that the tug *Tyee* would leave at once. The *Tyee* and *Unalga* stood by the *Kunajiri Maru* but their services were not required as the vessel floated the following morning and proceeded to Port Townsend for survey.

SS. *Princess Alice.*—On the 15th October, 1916, the ss *Princess Alice* sent a message through the Cape Lazo station, notifying her owners that she had run aground in Mensies bay. The *Princess Alice* floated off the next day with the assistance of the tug *Nitinat.*

SS. *Belfast.*—On the 16th October, 1916, advice was received from Hesquit, via the Estevan Station, that the ss. *Belfast* was anchored close to the shore at the entrance to Sydney inlet, in a dangerous position. The Ucluelet lifeboat left to stand by and the ss. *Belfast* wired to Seattle for a tug. This information was given to the U.S. Revenue Cutter *Unalga* by the Gonzales Hill station.

SS. *Santa Ana.*—On the 28th October, 1916, the ss. *Santa Ana* reported to the Ketchikan station that her low pressure crank had broken and that she was anchored off Maey island. The boat being closer to Ketchikan she maintained communication with that station, but the Digby Island station handled messages to and from the ship. The ss. *Valdez* took the ss. *Santa Ana* in tow early on the morning of the 31st October, 1916. When abeam of the Digby Island station bound for Seattle, the *Santa Ana* reported all well.

Barge Donald D.—At 8.45 a.m. on the 3rd November, 1916, the ss. *Prince John* reported by wireless to the Triangle Island station as follows: "At 11 p.m. last night the barge *Donald D* broke away from the tug *Dola,* eight miles west

of Pine island, strong easterly gale, heavy sea, tug short of coal, please send assistance to take off crew. *Dola* going to Alert bay for coal, *Prince John* now abeam Pine island going off shore see if can find *Donald D.*"

The Triangle Island station requested the Captain of the *Prince John* to do all in his power to assist, and also got in touch with other stations to render assistance. The crew of the *Donald D*, consisting of five men and one woman, were eventually rescued by the ss. *Prince John.*

SS. *Niels Nielson.*—On the 27th November, 1916, the ss. *Niels Nielson*, bound from Seattle to Vladivostock, with a valuable cargo, reported to the Triangle Island station that she had lost her propeller and required assistance; the vessel was then 103 miles from Triangle island. The Gonzales Hill station reported the accident to the tug *Snohomish*, which vessel left Port Angeles to render assistance. The tug *Goliath* was also dispatched from cape Flattery at midnight on the 27th November. On the morning of the 29th November the Gonzales Hill station requested the ss. *Niels Nielson* to keep the station posted as to her movements, and later received advice from the vessel, *via* the Estevan station, that she expected to sight the tug *Goliath* in two hours. Messages were also sent to the tugs and the *Goliath* replied at 1.50 p.m. that she was alongside the ss. *Niels Nielson*, and expected to have a hawser aboard her in a few minutes. At 10 p.m. the *Snohomish* advised that the *Goliath* had the *Niels Nielson* in tow, about twenty miles from cape Cook, and later that she had towed her safely to Victoria, assisted part of the way by the tug *Tyee.*

SS. *Stanley N. Dollar.*—On the 12th January, 1917, the Gonzales Hill station received a message from the ss. *Princess Alice*, advising that the ss. *Stanley N. Dollar* was ashore in Active pass and required immediate assistance. The B.C. Salvage Company was advised and the ss. *Salvor* was dispatched to the scene of the accident, arriving in the vicinity in four hours' time. Unfortunately, the *Salvor* also ran ashore, at 9 p.m., on Enterprise reef and was not floated off until 7 a.m. the following morning. In the meantime the *Nitinat* had arrived and pulled the *Stanley N. Dollar* off at 7.30 a.m. on the 13th January.

SS. *Prince John.*—On the 26th January, 1917, weak signals were picked up by the Digby Island station, from the ss. *Prince John*, stating that they were ashore in Wrangell narrows, taking water fast. The Digby Island station got in touch with the ss. *Prince Albert*, which vessel proceeded to the assistance of the *Prince John.* The tug *Pioneer* pulled off the *Prince John*, and she transferred her passengers to the *Prince Albert*, and then beached for repairs.

SS. *Princess Patricia.*—On the 7th February, 1917, the *Princess Patricia* went ashore at Point Grey and the tug *Qualicum* was sent from Vancouver, to render assistance. The assistance rendered by the Point Grey station enabled the *Princess Patricia* to be floated within five hours after the first report of the accident.

SS. *Santa Ana.*—On the 18th March, 1917, a message was received from the ss. *Santa Ana, via* the ss. *Norwood* and ss. *Northwestern*, advising that she was ashore near Craig, Alaska, but not making water. The *Santa Ana* was ashore for several days but eventually floated off safely.

SS. *Prince Rupert.*—On the 23rd March, 1917, a distress call was received by the Digby Island station from the ss. *Prince Rupert*, advising that the boat had struck the rocks and was filling fast and requesting immediate assistance. The nearest steamer in range was the ss. *Humboldt*, northbound. At the request of the captain of the ss. *Prince Rupert* the Digby Island station asked the *Humboldt* to return at full speed, which he immediately proceeded to do. Several other boats from Prince Rupert also left to render assistance. The passengers were taken off the vessel and brought into Prince Rupert. Constant wireless communication was maintained with the vessel.

East Coast and Great Lakes.

The radiotelegraph stations on the east coast and great lakes were not called upon to render any assistance to distressed vessels during the year.

NEW CONSTRUCTION, ADDITIONS AND ALTERATIONS.

West Coast.

Cape Lazo.—The old three-piece mast was found to be rotting at the base, so a large concrete footing was placed around it. New mast bands were made and the stays refitted. Preventer bands and stays were placed on the topmast, and the mast set up and painted. The tree mast was also set up and painted. All the apparatus was overhauled.

Dead Tree Point.—All the station buildings were painted, the mast was also painted and the rigging overhauled.

Estevan.—The rigging was overhauled and the mast painted. About an acre of ground was cleared and the digging of a well commenced. The tramway was improved by putting down new iron rails for the use of a gasolene car. The apparatus was overhauled and new piping in connection with the engine-cooling tanks put in. A new receiver was also installed.

Gonzales Hill.—The rigging was overhauled, and new preventer stays and strongbacks were put up. The masts were painted, a new aerial erected, and the earth system strengthened. New partitions were put up in the dwelling house, and a few minor repairs made to the dwelling and operating houses.

Pachena.—The apparatus was overhauled and put in good working order.

Point Grey.—The masts and rigging were overhauled and the masts painted. A new power-set and non-synchronous disc, to operate off the power mains, was installed and the station overhauled generally.

Triangle Island.—The masts and all apparatus was thoroughly overhauled and placed in good working order.

East Coast.

In pursuance of the policy of government ownership of radiotelegraph coast stations, an agreement was entered into with the Marconi Wireless Telegraph Company of Canada, whereby the North Sydney station has been transferred to the department for the sum of $5,365.44.

North Sydney.—In order to increase the range of the North Sydney station a second mast was erected at that point and the height of the existing mast increased to 165 feet; the operating house was also removed to a new position. The total cost of the above work was $1,827.69.

Great Lakes.

Point Edward.—Owing to the action of the Hydro-Electric Commission of Ontario changing the frequency of the power supply from 60 to 25 cycles, new transformers and motors had to be installed to supply power to the radiotelegraph transmitting apparatus. The total cost of the installation was $1,341.00.

Port Burwell.—A septic tank and drainage was put in at this station and surface well installed. The total cost of this work was $387.94.

Headquarters.—A tubular iron mast, one hundred and forty feet in height, was erected at the Naval Stores, Wellington St., Ottawa, for the use of this branch in connection with the testing of radiotelegraph apparatus.

Radiotelegraph Act.—The following amendments to the radiotelegraph Regulations have been made since the 1st August, 1914.—

SHIP STATIONS IN TERRITORIAL WATERS.

103. *The Radiotelegraph Stations on board ships* (other than H.M. ships of war or Canadian Government vessels) *shall not be worked while such ships are within the territorial waters of Canada, unless specific permission is granted therefor* by the controlling Canadian coast stations for the locality, and then only provided such working does not interfere with the operation of any coast station established in Canada, and that the provisions of the Radiotelegraph Convention of London, 1912, and the Service Regulations, annexed thereto, are strictly observed.

WAVELENGTH TO BE USED BY SHIP STATIONS.

106. All Canadian licensed Ship Stations shall use the wavelength of 600 metres exclusively during the period of hostilities.

NATIONALITY OF OPERATORS.

No. 88 (*a*). No person shall be permitted to attend examination for any class of certificate of proficiency in radiotelegraphy—

(i) who is not a British subject;

(ii) who has at any time been of enemy nationality;

(iii) whose parents were not of British nationality at the time of his birth;

(iv) whose parents have at any time been of enemy nationality.

(*b*) Candidates for examination for first-class certificate of proficiency must be not less than eighteen years of age.

(*c*) This regulation shall take effect on the 15th October, 1916, and shall remain in force until the cessation of hostilities, unless sooner repealed.

SHIP STATIONS IN HARBOURS.

104. (*a*) The Radiotelegraph Stations on board ships (other than H.M. ships of war or Canadian Government vessels) *shall not be worked whilst such ships are within a harbour of the Dominion of Canada.*

(*b*) For the proper enforcement of the above, *ships of British register in Canadian harbours must completely disconnect their aerial wires from their radio apparatus,* the ends of such wires being suspended entirely clear of the radiotelegraph cabin, preferably from the main rigging, *in such a manner as to show they are properly disconnected.*

(*c*) *Ships of foreign register* in a Canadian harbour *must* (subject to the provisions of the following subsection *d*) *take down their aerial wires completely* and disconnect the same from their radiotelegraph apparatus.

(*d*) Ships of foreign register remaining in a Canadian harbour for *less than thirty-six hours, may at the discretion of the competent naval authority*, be permitted to leave their aerials up, provided the same are disconnected in accordance with the provisions of subsection (*b*) of this regulation.

(*e*) Subsections (*b*), (*c*), and (*d*) of this regulation, relative to the disconnection of aerials in ships lying in Canadian harbours will not, until further notice, apply to Canadian or British vessels in Canadian harbours on the Great Lakes. Such vessels must, nevertheless, strictly observe the provisions of subsection (*a*).

Transports.—The department continues to equip transports plying to Canada with radiotelegraph apparatus, when requested to do so by the Admiralty. An efficient staff of wireless officers is maintained at Montreal, Halifax and St. John for the inspection of the wireless apparatus on all transports.

Personnel.—The personnel of the Radiotelegraph Service in the Dominion is as follows:—

	Government.				Commercial.			
	Headquarters.	Coast Stations.	Land Stations.	Ship Stations.	Headquarters.	Coast Stations.	Land Stations.	Ship Stations.
Engineers and officers in charge	1	20	2	47	9	20	10	64
Operators		40	5	30		40	16	5
Other employees	5	6			80		28	
Executive officials and inspectors	6	2		1	1			3
	12	68	7	78	90	60	54	72

Total personnel, 441.

I am glad to report that all members of the Radiotelegraph Service directly in the employ of this department continue to take a great interest in their work and have carried out their duties in a satisfactory and efficient manner.

I have the honour to be, sir,

Your obedient servant,

C. P. EDWARDS,

General Superintendent, Government Radiotelegraph Service.

FISHERIES PROTECTION SERVICE.

OTTAWA, April 15, 1917.

The Deputy Minister,
Department of the Naval Service,
Ottawa.

SIR,—I have the honour to report as follows with regard to the Fisheries Protection Service for the year ending March 31, 1917, as to the numbers of vessels and men in the service, their stations, brief descriptions of the vessels and the names of their commanding officers.

The ships of the Fisheries Protection Service still number nine, although the *Canada* has actually been commissioned under the White Ensign and has been serving in the Naval Service since shortly after the outbreak of war.

It is also pointed out that the increased requirements for coastal defence, necessitated by the continuance of the war, do not allow of these vessels being utilized very much for the duties for which they were originally commissioned, although the department makes every effort to see that the fisheries laws are strictly complied with and to have complaints made by the fishermen investigated at once.

NAMES OF VESSELS AND THEIR COMMANDING OFFICERS.

Canada.—Lieut. Commander C. J. Stuart, R.N.R.
Curlew.—W. J. Milne.
Constance.—J. E. Morris.
Petrel.—C. O. McDonald.
Gulnare.—Clement Barkhouse.
Vigilant.—P. C. Robinson.
Galiano.—Lieut. R. M. Pope, R.N.R.
Malaspina.—Holmes Newcombe.
Restless.—Charles Moore.

C.G.S. "CANADA."

Is a twin-screw steel ship, length 206 feet, beam 25 feet, draught 11 feet 2 inches, registered tonnage 411 tons, speed 16 knots. When on fisheries protection duty she is armed with two 12-pdr. Q.F. and two 3-pdr. Hotchkiss guns. The vessel is electrically lighted throughout, and is fitted with a powerful searchlight. Her complement is sixty officers and men, all told, and she was built by Vickers, Sons & Maxim, Limited, England, in 1904. She is commanded by Lieut. Commander C. J. Stuart, R.N.R.

This ship is commissioned under the White Ensign and has not been engaged in fisheries protection work since the outbreak of war.

C.G.S. "CURLEW."

Is a composite single-screw vessel, length 116 feet 3 inches, beam 19 feet 8 inches, draught 11 feet, speed 10½ knots and registered tonnage, 157.85 tons. Her complement is twenty-two officers and men, all told, and she is commanded by Capt. W. J. Milne.

April 1, 1916, found the *Curlew* engaged in patrol duty in the northern portion of the bay of Fundy, which was continued until the beginning of May, when she proceeded to Halifax for refit. The foremast and one of the fresh-

water tanks had to be replaced, and these, with other minor repairs, kept the ship in dockyard hands until June 30, when she returned to the bay of Fundy and resumed her fisheries duties, landing stores at the life-saving station at Little Wood island, *en route*.

On July 25, the *Curlew* was able to render some assistance in re-floating the ss. *Tyne*, which vessel had gone ashore on the Old Proprietor ledge, Grand Manan. On July 31, ship went in search of the barge *Mule*, adrift in the bay of Fundy, but the barge sank before assistance arrived.

During the month of August regular duties were carried out, including a watch being kept on the fishermen operating drift-nets for salmon in St. John harbour and off the New Brunswick shore.

On September 2 a lifeboat and stores were taken to Little Wood island from Digby, and on the 6th ship went to the assistance of the ss. *J. L. Cann*, which vessel was in a dangerous position off Briar island, with a broken shaft. On September 27 the *Curlew* embarked an official of the department and proceeded to Whitehead island, inspecting positions for life-saving stations, lookouts, etc. After returning him to St. John, ship cruised to the lobster fishing-grounds off Seal island.

At the beginning of October the life-saving stations at Seal island, Baker's cove, Westport and Little Wood island, were inspected by the commanding officer, the rest of the month being occupied in regular patrol work. Grand Harbour was visited on November 5, to watch the sardine fishermen. The catch in this locality was large and the prices good. The same may be said of the catch, earlier in the season, in St. John's harbour.

The *Curlew* located and reported an uncharted rock southward off Whitehead island on November 16.

On December 20 the ship cruised St. Mary's bay in search of the U.S. schooner *W. H. Mason;* this vessel foundered in deep water at the entrance to the bay, only the top of her masts being visible.

In January a new motor life-boat was towed from St. John to Little Wood island and moored in a sheltered position in the harbour ready for use. The life-saving station at Baker's cove was then visited and the damage done to the slip inspected and reported on. The *Curlew* remained at Yarmouth, breaking ice in the channel, until January 21, when she returned to patrol duty on the New Brunswick shore.

February 15 to 17 were spent breaking ice in the harbour of St. Andrews, to allow the traffic proceeding to the public wharf. On March 7 a lifeboat was taken from Little Wood island to Bay View, and on the 30th ship proceeded in search of a wreck, but was unable to locate it owing to weather conditions.

The winter being particularly cold and stormy very little fishing was carried on.

C.G.S. "CONSTANCE."

Is a single-screw composite steamer, whose length is 115 feet 6 inches, beam 19 feet 6 inches, draught 11 feet 6 inches, and registered tonnage 125 tons. Her complement is twenty-three officers and men, all told, and she is commanded by Capt. J. E. Morris.

The *Constance* came out of dockyard hands April 11, 1916, and immediately was utilized for war service, on which service she has been kept throughout the year.

C.G.S. "PETREL."

Is a steel, single-screw ship, length 116 feet, beam 22 feet, draught 9 feet, speed 11 knots, and registered tonnage 191 tons. Her complement is twenty-four officers and men, all told, and she is commanded by Capt. C. O. McDonald.

This ship was in commission at the beginning of the fiscal year, carrying out her regular duties, which she continued to do until May 19, when she pro-

ceeded to Little Wood island and left the ship's carpenter at the life-saving station to repair the launching ways, returning later to embark the carpenter on the completion of the repairs.

On June 16 the *Petrel* proceeded to Shelburne, calling at Victoria Beach to take in tow a life-boat for Halifax, which place was reached on the 22nd. Ship was placed in dockyard hands July 6 and remained until September 10, when repairs were completed and she was once more ready for sea.

After visiting the life-saving station at Clark's Harbour and reporting on the repairs necessary there, the *Petrel* returned to Halifax September 17, and from that date has been occupied on war service, although the commanding officer has inspected and reported on several life-saving stations when in their respective vicinities.

C.G.S. "GULNARE."

Is a steel single-screw vessel, whose length is 137 feet, beam 20 feet 5 inches, draught 12 feet, registered tonnage 262 tons. Her complement is twenty-five officers and men, all told, and she is commanded by Capt. Clement Barkhouse.

As was the case last year the *Gulnare* was employed continuously on Naval Service and was unable to attend to fisheries protection duties.

C.G.S. "VIGILANT."

Is a twin-screw steel ship, whose length is 177 feet, beam 22 feet, draught 9 feet 6 inches, registered tonnage 242 tons, and speed 16 knots. She is electrically lighted throughout and fitted with a powerful searchlight. Her complement is thirty officers and men, all told, and she is commanded by Capt. P. C. Robinson.

This ship went into commission at Port Dover April 14, but did not proceed to sea until the 21st when the Consulting Naval Engineer embarked and ship proceeded on trial trip, returning to port the same evening. The *Vigilant* then proceeded on her regular routine, visiting the life-saving station on Long point on April 25, and working on the boundary.

May 22 Captain King came on board to adjust the ship's compasses, disembarking on the evening of the 23rd. Ship then cruised on the boundary until June 11, when measles broke out in the ship and in spite of disinfecting, prevented much work being carried out until the early part of July.

July 14 the *Vigilant* left for lake Ontario, the director of the Naval Service embarked at Trenton on the 17th, and the various life-saving stations along the lake Ontario shore were inspected. On the 7th the ship returned to lake Erie, and the life-saving stations along that lake were inspected, the director of the Naval Service disembarking at Port Stanley on the 22nd, when work was resumed on the boundary. Fishermen now became very active off Long point, and work was practically confined to this part of the lake for the next couple of months. Life-saving stations were visited from time to time and work on the boundary continued until September 7, when the ship proceeded to Port Dover to land nets taken off Long point.

Stormy weather kept the vessel in port, and on the 16th the ice having become too bad, arrangements were made to lay up and the crew was paid off on December 23, 1916.

During the season of navigation, the ship steamed 5,818 miles, and seized 618 nets.

C.G.S. "MALASPINA."

Is a steel single-screw vessel, whose length is 160 feet, beam 26½ feet, draught 12½ feet, speed 14½ knots, and displacement 700 tons. She is electrically lighted throughout and fitted with a powerful searchlight. Her complement is thirty-three officers and men all told, and she was built by the Dublin Dockyard Company, Dublin, Ireland, in 1913. She is commanded by Capt. Holmes Newcombe.

April 1, 1916, the *Malaspina* was busy preparing for sea, taking on stores for various wireless and life-saving stations; she left Esquimalt with these supplies on the 6th and returned on the 10th, then proceeded on examination service until the 19th. The ship's boilers were then washed out and she proceeded to Vancouver on the 23rd with the admiral superintendent on board; here applicants for the motor-boat patrol were interviewed and ship returned to Esquimalt.

April 29, the vessel proceeded to Ucluelet and towed the life-boat to Esquimalt for repairs, returning May 1. Examination service was then carried out by this ship until the 23rd, during which time she was inspected by the director of the Naval Service. On May 24 the *Malaspina* took the admiral superintendent to Fulford harbour, returning the following day. Examination service was carried out during the month of June, with the exception of a day or two when the admiral superintendent was taken on short trips. July 7 the ship went into dockyard hands for overhaul, repairs being completed on the 24th, after which she coaled and on the 7th left for Vancouver, thence to Leonard island, where a scow was taken in tow to Tofino.

From August 1 to 8 the *Malaspina* was employed in laying cable from Leonard to Vancouver island, after which she returned to Ucluelet with the scow, and after obtaining water at Uchucklisit, proceeded to Estevan with stores for the wireless station. On the 10th, as the ship was returning to Esquimalt she seized the motor-boat *Greg* for infraction of the Customs laws and brought her to Esquimalt, the fish being sold the next day and the matter reported to the collector of Customs, who ordered the vessel delivered at the Marine Department's wharf at Victoria.

This was done on the 12th, the *Malaspina* afterwards cruising on the west coast and in Hecate straits until the 20th, when a leak appeared in the main boiler, necessitating return to Esquimalt, which was reached on the 25th. On the 30th the ship left for Vancouver for repairs, remaining there until September 28, then returned to Esquimalt and proceeding with the admiral superintendent to Telegraph harbour, returning to Esquimalt on October 3. From the 4th to the 23rd the ship was on examination service, then proceeded to deliver stores to the various life-saving and wireless stations; visited Prince Rupert on the 27th and commenced cruising in the Chatham straits, but was recalled to Esquimalt, where she arrived on December 3. She proceeded on examination service until the 22nd, then made a trip to Vancouver with the admiral superintendent, afterwards going into dockyard hands for refit.

On January 24 examination service was again taken up and continued until the end of the fiscal year.

C.G.S. "GALIANO."

Is a steel, single-screw vessel, length 160 feet, beam 26½ feet, draught 12½ feet, speed 14½ knots, and displacement 700 tons. She is electrically-lighted throughout and fitted with a powerful searchlight. Her complement is thirty-three officers and men, all told, and she was built at Dublin, Ireland, by the Dublin Dockyard Co., in 1913. She is commanded by Lieut. R. M. Pope, R.N.R.

The *Galiano* was at Alert Bay April 1, 1916, *en route* to Cape St. James with Mr. Stephenson of the radiotelegraph branch, who was sent to report on available sites for a radiotelegraph station. The ship then proceeded to Prince Rupert, where Mr. Stephenson disembarked, after which cruising was carried on in the eastern side of the Hecate strait, and two fishing vessels ordered to report to the collector of Customs, as they had no marks of identification or papers to show. She then proceeded to Alert Bay, exchanged wireless operators and on April 22 returned to Prince Rupert for coal, afterwards cruising on the west side of Hecate strait, thence to Triangle island and Union Bay for coal, as the latter had not been obtained at Prince Rupert. The ship sailed from

Union Bay April 29, on receipt of instructions to proceed to the northern end of the Queen Charlotte islands. On May 4 returned to Prince Rupert for stores, visited Triangle island again and then proceeded to Vancouver to meet the director of the Naval Service, who embarked on the 15th, called at Victoria and Esquimalt and then continued on a tour of inspection of various life-saving stations, etc., returning to Vancouver May 31, when the director of the Naval Service disembarked and ship returned to Esquimalt, going on examination service from June 3 to 25.

On June 26, Commander Shenton embarked, by instruction of the admiral superintendent and proceeded on a tour of inspection of the radiotelegraph stations, returning to Esquimalt July 7 for examination service, which continued until August 18. Ship then went on fisheries protection duty to Barkley sound, the salmon fishing on the Swiftsure Bank being then good. On the 23rd two boats fishing cod off Race Rocks, manned by Japanese, were ordered to report to the collector of Customs, as they had no papers or marks of identification. Examination duty was then resumed until August 28, when ship went on the ways at Yarrows for cleaning and painting of hull.

September 5 ship left for Prince Rupert and Triangle, transferring wireless operators and calling at various ports. Returned to Esquimalt on the 12th, left for Vancouver and made two return trips, and on the 19th left for Pachena and Estevan, transferring operators.

The *Galiano* was in dockyard hands from October 1 to 21, and from the latter date to January 25, practically all her time was spent in examination service. She then proceeded to Prince Rupert, arriving there January 30, cruised on the eastern side of Hecate strait, thence to Dixon's Entrance, returning to Prince Rupert on February 10. Left again on the 12th for the islands on the southern part of Hecate strait, bad weather prevailing practically all the time. After coaling at Union Bay ship arrived at Esquimalt on February 24 and on the 26th went into dry dock. Refit was completed on March 21, and shortly afterwards ship went on examination service, which continued till the end of the fiscal year.

C.G.S. "RESTLESS."

Length 71 feet, beam 17 feet, draught 7 feet, is commanded by Capt. Charles Moore.

The *Restless* is required for naval work and has been so employed since August, 1914. She was docked on June 11, 1916, for repairs, which were completed on June 26, and on December 4 underwent refit of machinery and boiler, returning to duty December 18, 1916.

C.G.S. "FISPA."

This vessel belonging to the fisheries branch was, in November, 1916, sent to Prince Rupert, to look after the protection of fisheries in that vicinity, as the regular fisheries protection vessels were not able to give all their time to this work.

The winter was an unusually severe one and as the vessel was small it was difficult for her to do much cruising. However, the various straits and channels were patrolled as much as possible up to the middle of April, when instructions were given the commanding officer to return south, and the vessel was returned to the inspector of fisheries on April 30.

I have the honour to be, sir,
Your obedient servant,

C. E. KINSGMILL, Admiral,
Director of the Naval Service.

LIFE-SAVING SERVICE.

OTTAWA, May 1, 1917.

The Deputy Minister,
Department of the Naval Service,
Ottawa.

SIR,—I have the honour to make the following report concerning the Life-saving Service of Canada for the fiscal year ending 31st March, 1917.

The type of life-saving station at present in existence on the east coast and along the shores of the Great Lakes is rapidly becoming useless, owing to the fact that the ocean-going vessels now in use have become so large as to reduce to a minimum the number of marine disasters. It should also be borne in mind that the fishermen in most instances are now provided with up-to-date motor-boats, and are therefore better able to provide assistance in a case of emergency than many of the stations, so that it would appear desirable to gradually do away with a number of the least useful stations.

During the year a different arrangement has been made for the inspection of the stations on the east coast; this duty is now carried out by officers of the Fisheries Protection Service, while cruising in the vicinity of the various stations and has been found to work out very satisfactorily.

NOVA SCOTIA.

Bay View.—Permanent crew. Throughout the year various disabled fishing boats have been towed in by the crew at this station. Besides this the schooner *Sam Slick*, 80 tons, which went ashore in Digby Gut on the 22nd December, was floated with the help of the steamer *Bear River*.

Canso.—Volunteer crew. The crew of this life-boat have rendered assistance to the following vessels during the year: 8th June, 1917, schooner *Helen & Mary*, with 22 fishermen on board, ashore at Booth shoal; 4th August, Canadian Government ship ashore at Starling rock; 5th September, schooner *Maton*, 20 persons on board, ashore on Middle Ground; 23rd September, *Hazel L. Ritchie* grounded in the harbour; 25th September, schooner *Coreau*, ashore on Whitman rock; 25th November, American schooner *Primer*, ashore on a ledge at Cape island.

Cheticamp.—Permanent crew. Assistance was as usual rendered in various forms to local fishermen, but nothing of a very serious nature occurred in this vicinity.

Clark's Harbour.—Volunteer crew. One schooner of 200 tons, with a cargo of hard coal, was given assistance by the crew of this life-boat on the 16th August, 1916.

Herring Cove.—Volunteer crew. This crew went to the assistance of one small disabled motor-boat which was being carried out to sea in a heavy north-west wind.

Seal Island.—Subsidized volunteer crew. Three vessels got into trouble in this vicinity during the year, but there were no casualties. The *Vesta* was sunk in Lobster bay on the 23rd July; the *Harold B. Cousins* went ashore on Black ledge on 24th July; and the *Little Elsie* was adrift to the southwest of Seal island, with one man aboard, for 21 hours on the 14th September. The crew went out in search of the *Vesta* and *Little Elsie*, and in the case of the *Harold B. Cousins* assisted in floating her and getting her under way to Yarmouth.

Westport, Brier Island.—Subsidized volunteer crew. Three wrecks occurred in the vicinity of this station. November 2, the schooner *Florence E. Melanson* at Green island; December 1, the schooner *L. M. Ellis* at Dartmouth Point ledge; and on December 18 the schooner *William Mason*, off Irish bank. In the first two cases there was no loss of life, but in the last no one was saved.

Whitehead.—Volunteer crew. The schooner *J. W. Margeson* was wrecked off Whitehead on December 18, 1916. The crew was rescued, but the life-boat was damaged beyond repair.

NEW BRUNSWICK.

Cape Tormentine.—Voluntcer crew. On the 22nd July the schooner *Ulva* struck a reef off Jourmain island, and the crew were brought ashore in a gasolene boat. The schooner *Wild Brier* foundered five miles west of Jourmain light on 22nd August, in a heavy squall. The crew was rescued.

Little Wood island.—Permanent crew. Several disabled motor-boats were towed in during the year. On June 7 and 8 assistance was rendered the schooner *Capsize*, and she was towed in to the breakwater. On July 23 the *Tyne* was given assistance, the life-boat standing by for two days and nights. Two men adrift in a fog off Muir ledges were brought in to safety on 26th July, and on 13th December a man blown adrift from Nova Scotia in a thick snowstorm was brought in and cared for for two days.

Richibucto.—Permanent crew. During the year assistance was rendered to the following vessels: June 16, barkentine *Rolf*, 200 tons, with cargo of salt; June 28, schooner *Stella McLean*, 50 tons; August 18 large fishing boat *St. Joseph;* October 26, schooner *Maud Weston.* Besides this various fishing boats were towed in, etc.

ONTARIO.

Point Pelee.—Permancnt crew. Services of various kinds were rendered by the crew at this station during the season of navigation. On the 23rd November the schooner *Freedna* went to pieces on the east side of the point in a southwest gale. The crew was saved.

Port Hope.—Volunteer crew. On September 15, 1916, the *Henry B. Hall*, 1,800 tons, was wrecked off Port Hope. The crew was saved.

Toronto.—Permanent crew. 53 small craft were assisted by the crew of this station during the season of 1916, besides which the crew answered numerous calls for assistance in the case of drowning accidents, etc.

BRITISH COLUMBIA.

Bamfield.—Permanent crew. This crew rendered assistance in the way of towing, etc., to several motor-boats with engine trouble, etc.

Ucluelet.—Permanent crew. On November 17 the tug *V.N.& T. No. 1*, adrift off Sidney inlet, was picked up by the crew; and at various times assistance has been given to fishing boats, etc.

I have the honour to be, sir,
Your obedient servant,

C. E. KINGSMILL, Admiral,
Director of the Naval Service.

LIFE-SAVING STATIONS OF CANADA.

No	Stations.	Established.	Coxswain.	Crew.	Description of Boat.
	New Brunswick.				
1	Little Wood Is. (P).	1910	Harry Harvey	8	36-ft. self-righting power boat.
2	Richibucto (P.N.).	1907	Thos. Legoof	7	Race Point surf-boat, 24 ft. long
3	Point Escuminac	1908	E. F. Flieger	7	Beebe-McLellan self-bailing.
4	Cape Tormentine	1912	I. Allen	7	Beebe-McLellan self-bailing.
	Nova Scotia.				
5	Baker's Cove.	1886	R. L. Baker	7	Dobbin's pattern self-righting, 28 ft. long.
6	Blanche	1889	Jas. C. Swaine	7	Beebe-McLellan surf-boat, self-bailing, 25 ft. long.
7	Clark's Harbour	1900	Byron Swim	7	Beebe-McLellan self-bailing, 25 ft. long, low ends.
8	Canso		J. J. Berrigan	7	Dobbin's pattern surf-boat, self-bailing, 25 ft. long.
9	Devil's Island	1885	B. H. Henneberry	7	Beebe-McLellan surf-boat, self-bailing, 25 ft. long.
10	Duncan Cove	1886	J. W. Holland	7	Beebe-McLellan surf-boat, self-bailing, 25 ft. long.
11	Herring Cove	1885	Edw. V. Dempsey	7	Dobbin's pattern self-righting and bailing, 25 ft. long.
12	Pictou Island	1889	Duncan McCallum	7	Dobbin's pattern self-righting and bailing, 25 ft. long.
13	Port Mouton	1889	Walter Cook	7	Beebe-McLellan surf-boat, self-bailing, 25 ft. long.
14	Scattarie	1885	Jas. Nearing	7	Beebe-McLellan boat on east side.
15	Seal Island (P)	1880	Smith G. Penny	7	Beebe-McLellan boat on west side.
16	Whitehead	1890	John Phalen	7	Dobbin's pattern surf-boat, self-bailing, 25 ft. long.
17	Cheticamp, (P.N).	1911	L. J. Aucoin	7	Beebe-McLellan twin screw motor boat.
18	Bay View, Digby (P.N.).	1911	J. W. Hayden	7	36 ft. self-bailing, self-righting power boat.
19	Westport, Brier Is.		Ralph Welch		Subsidized motor boat,
	P. E. Island.				
20	Priest Pond	1909	Chas. Campbell	12	Board of Trade rocket apparatus.
21	Charlottetown	1907	E. White	6	Beebe-McLellan self-bailing.
22	Souris	1907	Plus Cheverie	7	Beebe-McLellan self-bailing.
23	Cascumpeque		Joshua Hutt	8	Beebe-McLellan self-bailing.
24	Alberton.	1907	S. Gallant	12	Board of Trade rocket apparatus.
	British Columbia.				
25	Bamfield (P).	{1909 1907}	Geo. Murray	11	Self-righting, self-bailing, 36-ft. power boat.
26	Ucluelet (P).	1908	F. Tyler (act.)	9	Self-righting, self-bailing, 36-ft. power boat.
27	Clayoquot (P)	1908	J. McLeod	8	Doherty's improved Beebe-McLellan.
	Ontario, Great Lakes.				
28	Cobourg	1882	D. Rooney	8	Dobbin's pattern self-righting and bailing.
29	Collingwood	1885	R. H. McFarlane	7	Beebe-McLellan self-bailing surf-boat.
30	Goderich	1886	Malc. McDonald	7	Surf-boat.
31	Long Point (P.N)	1902	Jas. Smith	9	Surf-boat.
32	Point Pelee (P.N.)	1900	L. Wilkinson	7	Surf-boat.
33	Port Hope	1889	John McMahon	7	Dobbin's pattern self-righting and bailing.
34	Port Stanley	1885	W. Brown	7	Beebe-McLellan surf-boat, self-bailing, 25 feet long.
35	Toronto (P.N.)	1883	W. F. Chapman	14	Two motor launches.
36	Consecon	1898	R. Bedford	7	Dobbin's pattern self-righting and bailing.
37	Southampton	1907	Hector McLeod	7	Beebe-McLellan surf-boat, self-bailing.

NOTE:—Stations marked "P" have permanent crews, always on duty; those marked "P.N." have crews always on duty during the season of navigation. The other stations simply have volunteer crews, which drill twice a month and are called out on the occurrence of a wreck.

STORES BRANCH.

DEPARTMENT OF THE NAVAL SERVICE

Ottawa, September 25, 1917.

The Deputy Minister,
Department of the Naval Service,
Ottawa.

SIR,—I have the honour to submit the annual report of the Stores Branch for the fiscal year ending March 31, 1917.

1. PURCHASING AND CONTRACT SECTION.

The work of this section during the past fiscal year has materially increased in keeping with the expansion and increased activities of the service. In addition, the difficulty of obtaining supplies has multiplied enormously, but in spite of many obstacles the many demands made upon it have been successfully met. Prices in all lines have advanced materially and available supplies of raw materials have decreased, necessitating substitution and continual adjustment to meet these conditions. This applies to all lines, but more particularly perhaps to provisions and clothing. It is most gratifying, however, that the Canadian manufacturers and dealers, appreciating the situation, have, with few exceptions, realized their responsibilities and privileges under the Crown and have given our requirements preference over other demands.

Demands from the dockyards, including as they did supplies for Imperial Ships and Establishments, were much in excess of previous years, both as to quantity and variety. These were dealt with to best advantage, resulting in purchases and contracts aggregrating in value $1,282,599.

In addition, purchases to the value of $289,196 were negotiated locally from the several dockyards. Purchases were also negotiated by ships and establishments direct, mainly of fresh provisions, to a total value of $431,637.

Purchases were negotiated on behalf of the Imperial Government direct, exclusive of fuel, to the value of $854,116.

Contracts for supplies of fresh provisions were maintained on both coasts and at outlying points as necessary for the convenience of ships of this service, as well as of those of the Imperial and Allied Governments. Supplies obtained under these are included in the value of purchases negotiated by ships and establishments direct, as shown above.

Contracts for supplies of fuel were also maintained on both coasts. Purchases under these aggregated $2,204,448. This includes supplies for Imperial ships and transports.

Purchases of printing and stationery were negotiated through the Government Printing and Stationery department, as usual. These totalled in value $125,817.

During the year contracts were entered into for the charter of thirteen vessels in all. Expenditure under this head totalled $292,828. In addition, five vessels were purchased outright, involving an expenditure of $552,265. Contracts were also entered into for the contruction of twelve steel vessels of the trawler type, involving an expenditure of approximately $1,800,000.

Contracts were also entered into for the erection of various buildings, etc., involving a total expenditure of approximately $39,246.

Miscellaneous purchases to the value of $276,298 were negotiated in fulfilment of demands received from the Fisheries, Hydrographic, Radiotelegraph, Fishery Protection, and other branches of the department.

The following is a summary of liability incurred during the year:—

Provisions	$ 746,397
Clothing	879,985
Medical supplies	10,775
Naval stores	621,979
Fuel	2,204,448
Ordnance and ammunition	54,981
Stationery and printing	125,817
Miscellaneous	2,960,637
	$ 7,605,019

II. STOREKEEPING SECTION.

The growth and expansion of the service during the year have had a marked influence on the activities of the Stores Branch.

Various new phases of Naval Supply work having arisen in the course of the year, it has been necessary to extend the organization to cope with the new conditions. The original scheme of organization, however, still proves adequate for the requirements of the service.

The first consideration of the branch is given to Ships and Establishments of the Naval Service proper, whether Canadian or Imperial. The work of supplying stores and equipment to men-of-war being of paramount importance, every effort is made to provide for all their requirements promptly, and to render every assistance possible for their efficient maintenance. Satisfactory results have been obtained in this work at both Halifax and Esquimalt dockyards, and at other ports as necessary. Notwithstanding the present difficulty of obtaining and transporting supplies, all Canadian and Imperial ships calling at Canadian dockyards, transports under the Canadian and Imperial Governments, and ships of Allied Governments, have been supplied with stores of all descriptions required for maintenance and for carrying out necessary refits. Facilities are placed at the disposal of visiting ships on the station as for those of the Canadian Naval Service.

During the year eighteen vessels have been added to the Naval Establishment, of which one was purchased, thirteen chartered, three transferred from other departments, and one given to the department. Three vessels previously employed, one by charter, and two on loan from private individuals, were returned in the course of the year. In addition, a number of motor launches were engaged in patrol work during the summer of 1916.

As in the past, service has been rendered to the various services connected with the department. These are the Patrol Service, the Fishery Protection Service, the Examination Service, and the Hydrographic Surveys, having in all a total of twenty-seven vessels (the Fishery Patrol Service consisting of a number of smaller craft), the Tidal and Current Surveys, the Radiotelegraph Service, the Royal Naval Canadian Volunteer Reserve, the Life Saving Service, The Fish-breeding Service, and various other fishery establishments throughout the country. The supply of these services entails a very considerable amount of work, owing to the nature of their requirements, which, though often small, are special and altogether peculiar to themselves. As far as possible, uniform systems for supplying and accounting of stores are being adopted, with a view to obtaining greater efficiency with the minimum amount of expense.

The facilities maintained at the Halifax and Esquimalt dockyards are very complete, and provide for quick despatch at all times and under all circumstances. This is necessarily a factor of great importance, more especially under war

conditions. The absolute necessity of supplying the requirements of ships and establishments promptly so as not to hinder in any way the operations of the service, renders it essential that a large reserve of supplies be always available, and an efficient organization maintained to carry on the work. This work at the dockyards is under the charge of the Naval Store officers, who are directly responsible for the efficiency and effectiveness of the supply systems under their charge.

The variety of the stores handled for all services is necessarily very wide, the following being a general list of descriptions: Provisions; uniforms and clothing, and materials for making these; medical supplies, surgical instruments, and hospital equipment; lumber; metals of many kinds and in every state of manufacture; hardware and tools; textiles, flags and cordage; packings and rubber goods, paints, lubricating and fuel oils; glass, leather goods, brushes, furniture and furnishings, tackle; charts, meteorological and navigation instruments; and other miscellaneous supplies of almost every description; fuel; and ordnance, ammunition, torpedoes, and torpedo stores. Standardization of all supplies is aimed at, and particular attention is given to inspection, both of which tend towards greater efficiency, economy, and the maintenance of the high standard of quality required in all naval supplies.

The reserves of the supplies of the above descriptions maintained at both dockyards are of necessity large, since a considerable margin of safety is essential, as the requirements of the service cannot from their nature be forecasted with exactitude in advance. The state of the market for many materials, too, is abnormal, and prompt deliveries of extra quantities which may be required from contractors uncertain. As far as possible, provision is made each year for requirements based on the consumption of the previous year or two years. From time to time, however, changes in policy, additions to the fleets, or other unforeseen events occurring necessitate adjustments to meet the new conditions. In view of the great increase in the issues to ships and establishments, the value of the stock at both dockyards has been materially increased. At the commencement of the year the values were $469,618 and $351,611 at Halifax and Esquimalt dockyards; at the end of the year these values were increased to $488,150 and $534,816 respectively.

The usual procedure of annual requisitions for supplies required during the ensuing year, and supplementary requisitions for unforeseen requirements, has been followed, and very large deliveries have resulted. The total value of receipts of stores at Halifax dockyard was $805,282 and at Esquimalt $570,496, an increase of $165,186 and $268,630 respectively.

Likewise, the issues to ships and establishments have been largely increased both in number and value. At Halifax, the increase is $82,593, and at Esquimalt $127,936, the values for the year being $592,926 and $411,270, respectively. Transactions involved number 14,050 for Halifax, and 18,444 for Esquimalt.

The Imperial authorities continue to avail themselves of the facilities at the dockyards for keeping large supplies of stores for issue to ships operating in Atlantic and Pacific waters. Every assistance is afforded in connection with the storage and accounting of these stores.

In addition to the assistance rendered to Imperial ships in the past, arrangements were made in the course of the year to supply all the requirements of clothing stores and provisions for ships based on Esquimalt. Large reserves have been provided, and all necessary arrangements completed to ensure an efficient service.

Large reserves of steaming coal are maintained at both dockyards for Canadian and Imperial requirements. The total receipts during the year at Halifax amounted to 78,575 tons, and at Esquimalt 31,711 tons. The issues at Halifax were 77,733 tons, and at Esquimalt 29,626 tons. The greater part of these

quantities being of admiralty coal, the values are not included in the value of purchases. In addition, the following large quantities of Canadian coal were handled on direct issue to ships from contractors:—

At Halifax and the East coast	138,509 tons.
At Esquimalt and the West coast	16,545 "

Supplies of fuel oil are also maintained at both dockyards. In the year the following quantities were handled:

At Halifax	107,000 gallons.
At Esquimalt	22,943 "

Considerable quantities of old stores, chiefly in the nature of scrap, were sold by public tender from Halifax dockyard in view of the necessity for providing further storage space for other purposes, and the favourable conditions of the market for selling material of this kind. The stores, which included steel, iron, cordage, phosphor bronze, rubber, wire rope, besides two ships' boats, were classified into various grades according to quality and probable use when sold. The amount realized approximately $10,000, is highly satisfactory, and may be attributed to the care taken in the proper classification of the material.

Owing to the large number of ships added to the Naval Establishment, it has been necessary to draw up established allowances for engineers', carpenters', boatswains', and gunners' naval and ordnance stores for each ship. Particular care is given to the preparation of these allowances, so that the greatest conomy may be effected. consistent with the efficiency of the service.

All supplies of stores are made in accordance with the allowances, additional requirements being supplied only on special authority.

Ships and establishments, including the dockyards, keep accounts of all stores received and expended. These accounts are rendered to headquarters periodically for audit. In the year a large number of accounts have been audited, with satisfactory results.

The system of biennial stocktaking has been continued during the year, and good progress has been made, notwithstanding the pressure of other work. Under this system the stocks of all stores at both dockyards are reviewed in their entirety every two years. The results of the stocktaking made are very gratifying from every point of view, and testify to the efficient manner in which the staffs concerned have performed their duties, under trying conditions.

III. TRANSPORTATIONS.

The arrangement under which the department, in conjunction with the Director of Overseas Transport, is responsible for the necessary work in connection with the export of material on behalf of the Imperial Government have been continued in force and greatly expanded during the financial year 1916-17.

The Department of the Naval Service is the agent of the Admiralty in this connection, and during the fall of 1914 had arranged for the forwarding of large quantities of material on behalf of the Admiralty. Shortly after the outbreak of war the Canadian Pacific Railway Company placed at the Government's disposal, for transportation duties, the services of Mr. A. H. Harris of their staff. During the fall months of that year the transport of material forwarded by the Canadian Government to French and British ports had been performed under his direction. In December, 1914, it was realized by the department that efficiency would be promoted by co-operation and the co-ordination of our interests with those under control of Mr. Harris, who had been appointed Acting Director Overseas Transport by the Government. In February, 1915,

this gentleman, at the instance of the Government, visited London and arranged with the Imperial Authorities for the initiation and conduct of a regular Store Service between Canadian and European ports.

The Admiralty then placed a small number of requisitioned ships on this service. The Director Overseas Transport was given general control of the traffic inland, by rail or otherwise, its reception and storage of shipment, the allocation of the cargo to the different ships and storage on board of the various materials so as to ensure the maximum use of the tonnage placed at our disposal by the Admiralty.

In October, 1916, the Acting Director Overseas Transport again visited England and France at the instance of the Government. He discussed with the Imperial Officers controlling the European activities of the service, its further development and improvement with a view to obtaining closer co-operation of all interested parties. This exchange of views and the personal discussion of the problems involved has resulted in the simplification of many systems and in closer co-operation between the various services, Canadian, Imperial, and Allied, which it is confidently expected will result in increased efficiency.

Recently the growth of the tonnage to be shipped and the further extension of Government activities to commodities hitherto handled by private effort has made the provision of further cargo space imperative. The policy of requisitioning space on all liners sailing from Canadian ports has been adopted as the most convenient and efficient method of meeting the new situation. Eighty-five per cent of the cargo space on all liners was taken over by the Government at fixed rates. The remainder was placed at the disposal of the shipping companies for the accommodation of private shipments of foodstuffs or other necessary war supplies only. This arrangement has since been modified by the force of circumstances till practically all the space available is at the disposal of the Government. Arrangements have been made for the provision of space for approved shipments on account of private firms so that undue hardship may not result from the requisitioning of practically all the available ocean space.

In practice the inconvenience will be much less than anticipated, as Government supervision of trade has been extended to cover practically every branch of the Canadian activities, whether foodstuffs, raw materials, timber, or manufactured goods.

The Department of the Naval Service controls the movements of all ships, and is the medium of communication with the Admiralty on all matters of policy. All expenses in connection with the service are defrayed by the department on behalf of the Imperial Government on presentation of duly certified invoices.

Accommodation, as necessary, has been arranged for at the various ports. The facilities of the shipping companies have been at the disposal of the Transport Service, as required. Advantage has been taken of these to a large extent, and a very great debt of gratitude is owing to shipping and transportation interests for continual assistance and ready co-operation in all matters relating to the service.

Contracts have been made for the supply of bunker coal, as necessary; 230,000 tons have been purchased from Canadian firms for vessels in the service during the year ending March 31, 1917.

Arrangements have been made as necessary for the repair and fitting of ships for special purposes, and for the supply of such provisions, stores and gear as are required while the ships are in Canadian ports.

This service from a small beginning has grown to a very large undertaking. The average export movement for the year ending 31st March, 1917, amounts to more than 200,000 tons per month, or roughly eight fully loaded freight trains of

material per day. The monthly total now exceeds 400,000 tons, and the sailings two per diem. This traffic originates in all parts of Canada, and the work of organizing its transportation to the ports of shipment is very great. The services rendered by the Director of Overseas Transport and his staff in this connection cannot be overestimated.

The organization has worked with the greatest regularity and despatch. Practically no delays have been experienced throughout the period of review. The movement has been rendered possible only by the ready co-operation of all transportation companies with the staff of the service in all matters.

The traffic may, for convenience, be divided into two classes: first, "General Stores"; second, "Timber Shipments."

The first includes forage, grain, sugar and miscellaneous provisions, shell and ammunition of all kinds, militia stores, Admiralty supplies, and miscellaneous raw material and manufactured articles of a great variety.

The greater part of this traffic has been handled through the port of Montreal during the season of navigation, and from Halifax and St. John during the winter months.

In view of the importance of utilizing to the utmost every ton of shipping on the service, no efforts have been spared to give each ship the promptest despatch possible.

The remarkable success of these efforts may be seen from the following statement of the average time occupied in loading store transports at the ports of Montreal and St. John, N.B., for the nine months ending March 31, 1917.

	Montreal July 1 to Nov. 30.		St. John, N.B. Dec. 1 to March 31.	
	Days.	Hours.	Days.	Hours.
Time in port.....	5	19	9	0
Time actually loading	4	13	6	4
Idle Time...	1	6	2	20

The lost time includes stoppages on account of rain preventing work, Sundays, repairs and fitting of ships for special purposes, unloading westbound cargo and ballast, shifting bunker coal, and miscellaneous delays.

As regards the timber shipments, these have been made chiefly from Maritime Province ports. In addition a number of cargoes have been loaded on the Pacific coast and also at Montreal, Quebec, Rimouski, and the Saguenay river.

During 1916-17 shipments of timber totalling 333,000,000 were made under the jurisdiction of the Transport Service.

The organization of these shipments has required constant care and attention. The scattered ports of loading and the variation in conditions and equipment for handling the cargoes have made constant demands on the time and energies of the Director Overseas Transport and his staff.

The record is highly creditable in the difficult circumstances under which much of the work had to be performed, as will be realized from the following figures, giving the total average rates of loading timber ships for the nine months from June, 1916, to March, 1917, inclusive, at the St. Lawrence, Newfoundland, and Atlantic Coast ports: A total of eighty ships loaded, at an average rate of 183 standards, or about 360,000 ft.b.m., per weather working day during the nine months.

The accounting work in connection with the handling of these ships, it will be realized, is a large undertaking.

An arrangement has been arrived at whereby the labour for loading of the store ships at Halifax, St. John, and Montreal is supplied through the shipping companies. For each ship handled they receive an agency fee of $100. The labour is charged from the actual time-sheets of the employees engaged on the work, plus an overhead charge of 10 per cent to cover use of gear, superintendence, etc. A charge is made also to cover the time of the dock office staff engaged on transport work, checking, preparing of manifests, etc., based on the actual time worked. All payments on behalf of the ship, such as stevedoring, stores, petty repairs, etc., are defrayed in the first place by them, payment being made by the department on presentation of certified claims accompanied by original vouchers. Payments made in this manner aggregate, for the year ending March 31, 1917, $2,697,000.

In the case of ships loading at various other ports, arrangements are made locally by contract with local stevedores, or otherwise, as necessary.

All invoices covering coal are paid direct by the department, as are claims for special fittings, alterations, repairs, etc.

The following statement shows the disbursements on account of the Overseas Transport Service, April 1, 1916, to March 31, 1917:—

Bunker coal	$1,195,000
Stevedoring, ship's accounts, etc	2,697,000
Repairs, fittings, alterations	215,000
Total	$4,107,000

The thanks of the department are due the Canadian Pacific Railway Company for the services of a number of experienced transportation officers, without which this work could not have been carried out on the same scale with the excellent results achieved, and for their ready co-operation at all times, often at considerable expense and inconvenience to their own services. To the efforts of the Director of Overseas Transport are largely due the success of the operation of the whole service. His intimate knowledge of transportation problems of every kind, his resourcefulness in times of difficulty, and his indefatigable efforts at all times for the good of the work have made its successful operation possible in the face of many handicaps. He has been greatly assisted by his principal assistant, on whom the detailed work in connection with the movement of traffic largely devolved; by his representative in Halifax, who has been largely responsible for the organization of the timber service; and by his dock superintendent, who supervised the loading of transports, and to whom is largely due the celerity with which this work has been performed; his accountant has also performed valuable work, and the staff of each of these officers have given their services to the work in a very whole-hearted manner.

To the success of the efforts of these gentlemen in furnishing a prompt and efficient means of transportation is undoubtedly due the increasing magnitude of the orders now being placed for the products of the mines, forests, fields and factories of Canada by the Imperial and Allied Governments.

GENERAL.

During the period under review the work of the branch has increased materially in all directions. New members have been added to the staff to cope with the increased work, and the employment of a number of female clerks has been resorted to, with satisfactory results, in several important lines. The honest and whole-hearted way in which the members of the staffs at the dockyards and at headquarters have carried out their duties is a source of gratifica-

tion. At the dockyards, especially, the work has been strenuous. Constant unforeseen requirements arise, and the manner in which emergencies have been met reflects credit on the Naval Store officers and their staffs. At headquarters the year's work has been carried out satisfactorily according to schedule. The Naval Store officers at Halifax and Esquimalt, and the heads of the Purchasing and Storekeeping divisions in Ottawa deserve much credit for the satisfactory way in which the work of the branch has been done. To these officers, in a great measure, is due whatever success has attended our efforts to maintain an efficient supply and contract organization.

I am, sir, your obedient servant,

J. A. WILSON,
Director of Stores.