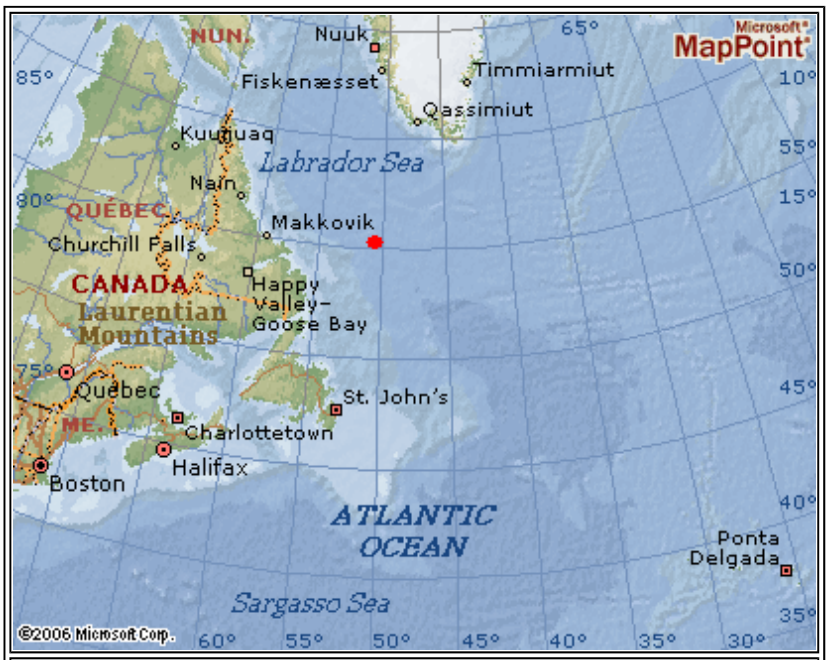
WEATHER SHIPS

GENERAL

After World War II, the passenger aircraft replaced the passenger liner for travel across the Atlantic and Pacific Oceans. With the advent of this service, good weather forecasting became necessary. Actual weather observations taken on a regular basis had to be performed from various areas of these two oceans in order to develop forecasts. The world's major political powers came together on this idea in London England and as a result, Ocean Weather Stations (OWS) were created in 1946. Canada was placed in a position of assisting the United States in manning one of these stations in 1947. There were three major objectives for the OWS:

* To provide positional information for long range, propeller flights over the Pacific and the Atlantic.
* Weather forecasting and measurement of winds aloft .
* For long range aircraft flight planning based on weather observations.

These stations were designated at various positions throughout both oceans and the positions chosen so as to fill the gaps where there were no shipping lanes and from where no weather reports came. Each position was assigned a letter for identification purposes. The first half of the alphabet became the Atlantic areas and the second half, Pacific areas. Canada and the United States were to share station 'B'. Since this undertaking became the responsibility of the International Civil Aviation Organization (ICAO) the International Telecommunication Union (ITU) assigned a block of call signs for their use. This block spanned from 4YA to 4YZ. The ships were not only to provide surface weather observations but also of the upper air pressure, temperature, humidity, wind direction and speed. They were also equipped for search and rescue operations for both ships and aircraft.



Station 'B' for Baker, as it was called in that era, was situated at 56.3°N, 51°W and was shared between Canada and the US until 1950. *(Map courtesy MSN Encarta Maps)*

Station 'P' for Peter (later called Papa) was Canada's exclusive weather station at 50°N, 145°W from 1950 onwards. It was approximately 900 miles from Vancouver over water 4220 meters deep. The station was operated from 19 December, 1949 through 20 June, 1981. *(Map courtesy MSN Encarta Maps)*

After one of the ICAO meetings, Canada was given the job of maintaining station 'P' in the North Pacific and relinquished her half share in station 'B' mentioned above. Three of the River Class Frigates were taken over by the Department of Transport, (DOT) extensively modified and crewed by D.O.T. personnel. One Frigate was HMCS St. Stephen , a three-year veteran of station 'B'. The other two were HMC Ships St. Catharines and Stone Town.

After the three ships were taken over by the DOT they became CGS St. Catharines, CGS Stone Town and CGS St. Stephen. The CGS stood for Canadian Government Ship. All the DOT ships, the buoy vessels, icebreakers and so on were known as CGS. They had civilian crews, were members of the DOT and operated as a merchant ship. The personnel consisted of: Masters, Mates, Engineers, Chief Stewards, Radio Officers, Electricians, Weather Observers and any other trade that was needed to get the job done. Radio operators were required to have their commercial deep sea radio certificate in order to work for the Department of Transport.

The government of Prime Minister John Diefenbaker decided to consolidate the duties of the Marine Service of the Department of Transport and on January 28, 1962 the Canadian Coast Guard was formed as a subsidiary of DOT. As a result, the three weather ships became Canadian Coast Guard Ships along with the rest of the DOT fleet including the Buoy Vessels, Icebreakers and so on. The crews remained the same as before. All the ships were repainted with a red hull, white superstructure, white funnels with red maple leaf on the funnel when their turn came up for refit after 1962. Before that, all the ships sported a black hull, a white superstructure and a buff funnel prior to 1962. Prior to the establishment of the Coast Guard, the organization responsible for marine safety was the Canadian Marine Service (CMS).

The Coast Guard did not take over anything. Everything simply became Coast Guard. Example - The CGS prefix for the ships became CCGS. The Captain of CGS Tupper, the same man, became Captain of CCGS Tupper and wore the same uniform, received the same pay and so on.

So how long was the rotation period while the ships were on station? On the US side, a typical weather patrol was 21 days on-station plus enroute time and about 10-days in port. It is believed that the Canadian rotational period was similar when station 4YB began operations. One source stated verbally it was 30

days for the Station 'B' era so there is some consistency there. The CCG book USQUE-AD-MARE chapter on the weather ships indicates that during the Stone Town / St Catharines era, rotations were on a six week basis. Quadra /Vancouver did a rotation with seven weeks at sea and five in their home port. The round-trip time consumed nearly a week.

WEATHER SHIP CHRONOLOGY

HMCS WOODSTOCK

There were several Canadian warships sent out as Weather Reporting Ships to various parts of the world's oceans during World War II. Canada's first weather observation ship was the Flower Class corvette Woodstock K238, radio call sign CYQZ. On January 27, 1945, she was paid off in Esquimalt for conversion to a loop layer but upon recommissioning on May 17, she was employed as a weather observation ship and shared a patrol with United States ships some 500 miles westward of Vancouver Island. Woodstock's weather observation services predated the international World Meteorological Organization (WMO) agreement of 1946 . The ship finally paid off on March 18, 1946.

HMCS Woodstock in her WWII camouflage. *(Photo courtesy Naval Museum of Manitoba)*

HMCS ST. STEPHEN

The Royal Canadian Navy had to supply a ship for weather station 4YB so they assigned the River Class Frigate HMCS St. Stephen. She carried out these duties on a rotational basis with an American ship from Sept 27, 1947 to August 1950. Since the weather branch of the Canadian government was a part of the Air Section of the Department of Transport (D.O.T.), St. Stephen was crewed by a complement of some ninety officers and ships company, and a civilian staff of five Department of Transport meteorological observers.

ST. STEPHEN as a weather ship. *(Image courtesy Frigates of the RCN 1943-1974)*

Paid off from the navy in 1950, she was sent to Esquimalt to be loaned to the Department of Transport (DOT) for use as a weather ship and assigned call sign CGGR. Ultimately she was retained primarily as a spare ship in the event of a mishap to Stone Town or St. Catharines. St. Stephen never left port. In spite of never filling the role as a backup ship, she was nonetheless refitted in 1955 and remained berthed in Victoria. St. Stephen was purchased by the DOT in 1958 and retained for another 10 years until she was sold to a Vancouver buyer purportedly for conversion to a fish factory ship. Stories about the St. Stephen which appeared in Crowsnest Magazine can be found here.

A weather balloon being inflated aboard ST. STEPHEN at Baker station. Also shown is the radiosonde and the radar reflector. Note the padded deckhead to ensure nothing can puncture the balloon. *(Photo believed to be taken by W.S. Walker via Sandy McClearn)*

Some naval references indentify St. Stephen as having pendant 323. This is incorrect. In the inset, this photo clearly associates the name of St. Stephen to pendant 302. *(Photo via Sandy McClure)*

ST. CATHARINES

Paid off from the RCN on November 18, 1945, St. Catharines was sold to Marine Industries Ltd, and laid up at Sorel, Quebec until purchased by the Department of Transport in 1950 and converted to a weather

ship. She was then transferred to the west coast where she took up station 'P' in December 1950 under the command of Captain J. S. Sleight. Her call sign was CGGQ . Jointly with Stone Town, these two ships provided this service for sixteen continuous years. In March 1967, St. Catharines was replaced by CGS Vancouver and was then broken up in Japan in 1968.

CCGS St.Catharines, call sign CGGQ. Her radar antenna is the 'AUK' type which means the ship is fitted with the 277P radar. Note the flush deck and modernized bridge. It's estimated that this photo was taken between 1962 and 1967. *(Canadian Coast Guard photograph submitted by Spud Roscoe)*

STONE TOWN

While being tropicalized at Lunenburg, NS for service in the Pacific, WWII ended and the work on Stone Town was stopped on August 24, 1945. After being paid off in November of that year, she was laid up in Shelburne NS for a while before being sold to the Department of Transport for use as a weather ship. She was modified for that purpose at Halifax in 1950 and in October of that year, Stone Town sailed to Esquimalt for duties at weather station 'P'. The ship's assigned called sign was CGGP. Some naval reference books indicate Stone Town as having pendant 302. This is incorrect. She was paid off after WWII and was never re-commissioned having been sold to the Department Of Transport. Pendant 302 was actually assigned to St. Stephen.

In June 1952, twice-daily bathythermograph casts were initiated at Station P and continued to June 1981. By July 1956, oceanographic observations including hydrographic casts to maximum depth of 1200 metres (m), plankton hauls, etc. commenced. They were scheduled for one of the two weather ships and provided data for alternate six-week periods. The maximum was increased to 2000 metres later but only in a few instances did the cast reach 2000 metres during 1957 through 1959. However, one cast to 3000 metres was recorded in 1957. By March 1960, maximum depth of hydrographic casts at Station P increased to 4200 metres.

Barrie Hastings who served on weather ships provides some information on staffing and work assignments. "Both the old and new ships carried the same total complement of roughly 50 personnel. This would include 9 radio operators, 7 upper air meteorologists one, often two oceanographers from the Pacific Oceanographic Group. There were no Radio Electronics technicians on the old ships, only the newer ones.

Within the radio group, there was one Officer In Charge (OIC) , and two radio operators doing radar ops and maintenance. One was on a day watch; the other on night watch. The remainder were watch keepers. There were always 2 operators in the radio shack. One held down the Aeronautical position (and its other duties), while the other operated CW on 4, 6, 8, 12, 16, and 22 MHz and monitored the marine bands.

In addition, the watch keeper was responsible for meeting scheduled radio facsimile reception times to obtain weather maps from either Honolulu or San Francisco. The Marine Position guarded 500 KHz and voice 2182 KHz along with providing point to point communications with Vancouver Radio VAI.

The old frigates did not carry a ship-shore telephone system which would enable crew to call home. That was fitted on the new replacement ships. The only communications for crew and family was a letter which was termed a “radio deadhead” message. A Deadhead classification indicated there was no charge (like a paid-for ship to shore radiotelegram). Both families ashore and crew were asked to keep the quota to one letter a week and the message no longer than 25 words in length. Radio deadhead CW traffic from Radio VAI was sent usually sent to the ship during the 0400-0800 watch. Messages from the ship to VAI were generally sent on the 0000-0400 watch. All business, ship, meteorological, personal mail etc was sent in CW on the old frigates. When the newer ships came into service, radioteletype would serve this function.

In the aeronautical position, the operator was responsible for “being aware” of various flights but with particular attention to aircraft that might come in range of our radar for plot purposes (ie within 100 NM). With an impending aircraft approach, he/she would alert the on duty radar operator who would go into the radar Ops room and start searching in the appropriate quadrant. Once targeted, the operator would give readouts to the bridge who would do a manual plot. This was usually done by the Bridge Officer. With several readings, he could then give a track and ground speed interpolation report.

The marine radio officers on the 2nd and 3rd watches copied the plain language High Seas Forecast from San Francisco Radio KFS. Each day, there was an early morning and evening plain language forecast. This gave the various locations of high and low pressure systems, frontal systems, anticipated gale, storm or hurricane force winds. Ocean Station Papa had one of the "best" locations of probably all the OSV’s. Best meaning right in the middle of air circulation patterns, 900 miles out fropm land and south of Alaska. This was the perfect recipe for the creation of gales, storms and hurricane force winds. Summer wasn’t bad, but in the winter months we always had a good ride!!”

Some OWS ships volunteered to carry out surface weather observations while enroute. This would include precipitation, visibility, sea conditions, wind direction and speed along with latitude and longitude. This information would be coded into 5 figure groups. There would be about 12 to 13 groups per observation. The 24 hour clock is divided into 6 hour groups, each called a major synoptic. The lesser synoptic is groups of 3 hours. Volunteer ships only sent reports during the major synoptics. If the ship was within range on 500 KHz, the operator would call until he was answered and given a turn on the working frequency. The OBS report was then sent to an OSV.

Every trip out and back, the ships carried out ocean studies. I forget how many stations were involved, but about every 6 to 8 hours we dropped a cable to which bathometer bottles were attached. With this arrangement, we studied depth temperatures, plankton levels , etc . While on station, there was also a similar program carried out daily. We also released four radiosondes per day which provided met data up to 50,000 feet.

Meteorologists aboard the weather ships were called “upper air” Met Officers. They not only made surface observations, but released the massive balloons which carried a radiosonde transmitter and radar reflector. Getting that massive balloon and its trailing equipment was quite a challenge particularly in high winds and high seas. When inflated using helium, they were quite large. Timing was everything. As the stern dropped in the seas, it was release time. If you didn’t do it right, the radiosonde transmitter might hit the ships rail. Once released, the radar operator would acquire it as quickly as possible, giving distance and elevation. The sonode equipment would be transmitting data on air pressure and temperature back to the Met shack. As each specific report was compiled, a meteorologist would deliver them to the

radio room. Some of the reports were an average of thirty 5 figure groups to a message, some 50 groups or more. The marine position now sent those messages via CW to Radio VAI. There were a few operators who preferred a hand key (and were very good), but the majority of us used Vibroplexes".

In October 1967, after 17 years of being on station in the North Pacific, Stone Town was replaced by CGS Quadra, and then sold in 1968 to a Vancouver buyer, purportedly for a conversion to a fish factory ship.

While in service, Stone Town had an amateur radio operation aboard. Call sign VE0MC was registered to C.M.S. Stone Town Amateur Radio Club, Victoria BC . There is one report of a confirmed contact with the ship at 0307 GMT on July 10th, 1962, on 14130 kHz using Upper Side Band. Not much else is known about VE0MC. It is also confirmed that St. Catherines and Stone Town operated VE0MZ and VE0MP[2] respectively. These call signs were transferred to CCGS Vancouver and CCGS Quadra (respectively) when the old ships were retired.

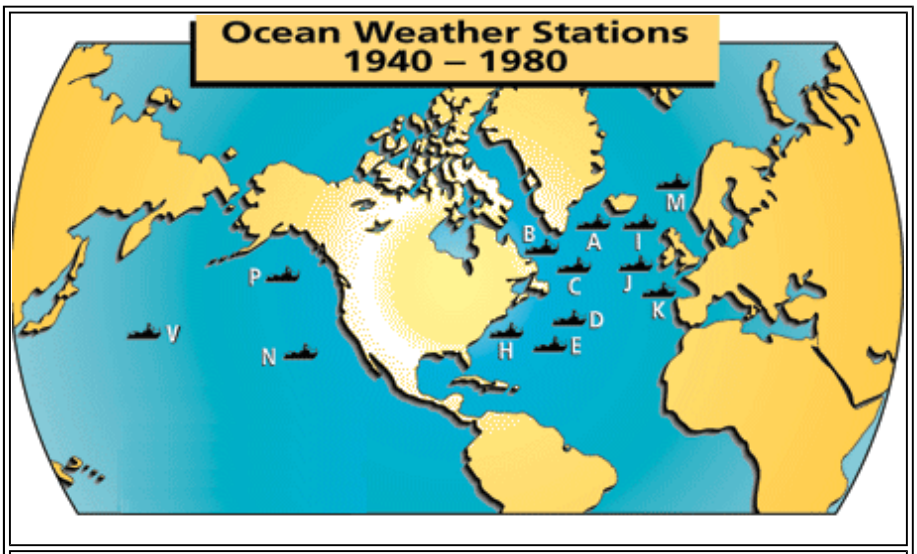
Back in those days, the VE0 prefix was assigned to a club with a sponsor and the sponsor was accountable for all activities of the station. In a Canadian port, a VE0Mx call could operate just like any other amateur station. When the ship was beyond the Canadian 3 mile territorial limit, operation was restricted to 14000 to 14250 kHz on 20 meters and any frequency in the 15 and 10 meter bands. In order to operate in the US or US territorial waters, the station sponsor had to secure a special card from the FCC.

CCGS Stone Town outboard of CCGS St. Stephen. Stone Town is fitted with her 277P radar as attested by aerial outfit 'AUK'. Because St. Stephen had become a parts source to support the other two ships still in service, she never left port. Notice the missing 277 antenna on her foremast when compared to Stone Town. *(Canadian Coast Guard photograph submitted by Spud Roscoe VE1BC)*

By 1970, the WMO was assigned the block of calls C7A to C7Z and the reason was not clear as to why an additional block of call signs was even necessary. The only C call sign ever heard was C7H. By 1948,

all U.S. stations were manned continuously except Station H. That station was operated only from 1952-54 and again from 1971-76. It is speculated that this may be the reason for using the C7H call sign rather than 4YH.

Each station was identified with a letter and this letter was the suffix of the call sign. There were seventeen stations only so one would assume the ICAO 4YA to 4YZ calls would have been sufficient. The stations were called by the same names as used in the International Phonetic alphabet. This alphabet was altered from time to time so Station B was referred to as Baker initially, then later as Bravo. Similarly station P started off as Peter and ended as Papa. To see how the phonetic alphabet evolved, select this link. The station assignments are summarized in the following table and map:



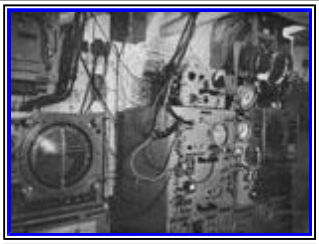
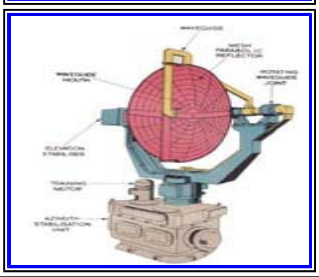
Ocean weather stations by location. After their establishment, they started to slowly disappear. An ICAO commitment basically kept 4YP and 4YN in the Pacific active. *(Graphic courtesy Wood's Hole Oceanographic Institute)*

ATLANTIC STATIONS			PACIFIC STATIONS		
STATION	**POSITION**	**OBSERVER**	**STATION**	**POSITION**	**OBSERVER**
4YA	62N 33W	USA & Netherlands	4YN	32.3N 135W	USA
4YB	56.3N 51W	USA & Canada until 1950	4YP	50N 145W	Canada
4YC	52.45N 35.3W	USA	4YQ	43N 167W	USA
4YD	44N 41W	USA	4YS	48N 162E	USA
4YE	35N 48W	USA	4YU	27.4N 145W	USA
4YH	36.4N 69.35W	USA	4YV	31N 164E	USA
4YI	59N 19W	Great Britain	4YX	39N 153E	Japan
4YJ	52.3N 20W	Great Britain & Netherlands			
4YK	45N 16W	France & Netherlands			
4YM	66N 2E	Norway			

The United States built 98 ships from the plans of the River Class Frigates and called them the Tacoma Class Patrol Frigates. They were naval ships as in USS but they had U.S. Coast Guard crews. As a matter of fact the first two, PF1 Asheville and PF2 Natchez were built in Canada. Some of these Patrol Frigates were used as weather vessels during the war. Many vessels assigned these ocean stations after the war were these former Patrol Frigates.

Barry Hastings was one of the Radio Officers in the three former Frigates assigned to station P. He describes the radar fit. “The radar equipment aboard the River Class frigates St. Catherines and Stone Town, which manned 4YP for many years, was the British designed type 277Q [1]. With all the right adjustments one could track an aircraft but this was really tricky. We used to do aircraft plots on these rigs while on station 4YP and we got pretty good at it. Propeller aircraft were typically tracked up to 80 miles and on occasion 95 miles but all we could get on him was a quick bearing, distance and that was all. "

277 RADAR PHOTOS

	277 Office. Click to enlarge. 1 - PPI Display; 2 - 'A' Display; 3 - HPI display; 4 - Aerial bearing indicator. Click to enlarge. *(Courtesy CB 4182/45 Radar Manual via Øyvind Garvik)*
	277 Aerial Outfit 'AUK' Click to enlarge. *(Courtesy CB 4182/45 Radar Manual via Øyvind Garvik)*

On a map, an Ocean Station was an area 100 nautical miles E-W and 100 nautical miles N-S divided into 10 nautical mile squares. The center square, which the ship usually occupied, was designated “OS” meaning “on-station”. If the ship drifted off by 10 nautical miles, the captain had the ship moved back to OS. This could be quite challenging when the weather was bad because the ship acted like a sail.

Weather ships had a radio beacon transmitting the call sign of the station in Morse code and the square in which the ship was located. For this function, Canadian weather ships used an endless loop of tape to key the transmitter. Overflying aircraft would check in with the ship and receive its position, course and speed by radar tracking, and weather data. When on station, a ship had to stay within a ten-square mile area of the assigned position. Once the ship was outside the boundaries of the station area, the beacon would be shut off.

Barry Hastings confirms the beacon ID. " The beacon identification for 4YP were the letters **YP** followed by the two identifying grid letters. Aeronautical radio beacons were assigned individual frequencies and the two letter identification would provide positive identification of the beacon.

Those who communicated with the River Class frigates will best remember them by the call sign 4YP.

REPLACEMENT SHIPS - CCGS Vancouver and Quadra

This excerpt from the Coast Guard web page provides the final chapter in the history of the weather ships.

"By 1960 the Department (of Transport) began to consider the question of replacements and, in 1962, tenders were called for two very advanced weather ships. These were Vancouver and Quadra, which were put into service in 1966 and 1967 and replaced St. Catharines and Stone Town respectively.

These two ships were of steam turbo-electric twin screw propulsion and had an endurance of 8,400 miles at a cruising speed of 14 knots. Although they could steam at 18 knots, the work called for a high degree of mobility at very low speeds and the vessels were therefore designed as stable, and very manoeuvrable, platforms with highly complex equipment. To obtain measurements of the temperature, pressure and relative humidity of the upper atmosphere, balloons were released at intervals of six hours. These balloons contained radio equipment that transmitted the required information, the balloon itself was tracked by a radar installation that fed azimuth, elevation and range into a computer that automatically produced printed charts of upper wind speeds and direction. In addition the weather ships maintained constant records of other meteorological and oceanographic phenomena and provided a radio beacon aid to trans-Pacific aircraft.

Operating in rotation with seven weeks at sea and five in their home port of Victoria, the Vancouver, Captain Linggard, and the Quadra, Captain Dykes, provided an unusual routine. The work at sea was constant and meticulous. Ships and men were always ready to provide search and rescue help in case of disaster to an aircraft or ship within reach. All on board were able to function efficiently and harmoniously within the confines of shipboard life, conditions that required high personal qualities because the weather in that area of the North Pacific was always stressful on the crew. The prevalent conditions usually included a heavy swell or sea, low visibility, and a general lack of sunshine."

Barry Hastings provides operational information on CCGS Quadra and Vancouver. "For crew staffing, it was the basically the same as the old ships except we now carried two Radio Electronic Technicians. The new radar system and other electronics had automated a lot of the tasks formerly performed by the radio operators. Because of that, there were some additional duties added.

The Marine Position now manned the radioteletype (RTTY) and the ship-shore telephone system. Even though we had RTTY, CW was still essential due to the unreliability of the RTTY equipment which operated on HF in the 4, 6, 8, 12, 16, and 22 MHz. bands It was not a “handshake” system whereby the transmitters would exchange signals, confirm signal compatibility, do corrections etc. We would cut a Baudot test tape and send our test message which was the continuous letters RYRYRYRY TEST etc. If received correctly, the communicator at radio VAI might send back an acknowledgment to send traffic IF…and I do mean IF… it was garbling…the radio operator at Vancouver would call us on HF voice or CW and try request than another channel be used. Again, the RYRY test message would be sent. If communication on RTTY could not be established, the ship would ask if anyone at VAI can copy a spark gap transmitter. This either elicited a laugh from VAI or an obscenity response. The new SSB ship/shore telephone operated on HF in the 4, 6, 8, 12, 17, and 22 MHz bands. Crew were again limited to one phone call a week with a 5 minute maximum duration.

This was the QSL card used by the Vancouver's Amateur

Radio Club. The station was fitted with Collins 'S" line equipment running 600 watts into a 35 foot vertical antenna. *(QSL card image provided by Barry Hastings).*

With the new ships came a better radar in the form of the Sperry 6504. The radar antenna was housed under the giant radome over the wheelhouse. (The system was designed to track rockets at Cape Canaveral, but it didn't prove efficient for that project). When the radio operator (radar) targeted the upper wind balloon on launch, you could lock the radar on and it would do all the tracking. A computer generated all the data on distance, elevation azimuth etc. When targeting an aircraft, it would provide constant readouts on track and ground speed. The only minor problem was when the antenna was on its back (high elevation angle). If it lost the target, the antenna would drop back to its stops (full down position). Imagine the noise made in the wheelhouse when a 9 ton antenna would come crashing onto its stops. When it happened we would get the most obscene phone calls from the bridge officer who was no doubt shaking in his boots by this time!

When not on station. CCGS Vancouver used her normal call sign CGBR The ship was assigned VE0MZ as a permanent amatuer radio call sign and held it until her retirement"

Between April and October 1974, CSS Parizeau replaced CCGS Quadra while the latter was occupied with the GATE program.

Vancouver and Quadra Vital Statistics

Type: Weather ship, twin screw, steam turbine
Built: 1966 Burrard Dry Dock, N. Vancouver
Length: 414 feet; Beam: 50 feet ; Draught: 17.5 feet
Displacement 5537 tons
Horsepower: 2 x 3750 SHP

CCGS Vancouver. *(Photo courtesy Canadian Coast Guard)*

Vancouver and Quadra saw their last weather service in 1981 when ocean station 'P' was terminated.A final series of observations was made by CCGS Quadra in June 1981. Modern technology rendered the weather ship obsolete. It was to be the end of an era. The Miramar Ship Index shows that Quadra sank in

tow on November 1, 2002 at Lat 30.58N Long 138.22W. Vancouver is listed but nothing about her disposal.

In their half century of ocean station operations, weather ships became an epoch of maritime history. They filled a niche in meteorology, oceanography, national defense, and safety at sea. The ships now are gone and ranks of the pilots who flew over them and the crews who sailed in them are fewer each year, but their role in the lore of the sea will remain forever.

Notes:

[1] Type 277 was a 10 centimetre surface/low air search set introduced into naval service in 1944. It was intended for accurate height finding. Power output was 500 kw. Except for the antennas , it is identical to the 293 set. The weather ships used both the 277-P and 277-Q sets so that means aerial outfit ANU or AUK could have been fitted. A detailed description of the 293 set can be found here.

[2] VE0MP was formerly assigned to RCMP MACBRIEN when John Stevens VE1RX was her radio operator. The vessel was in service from 1945 until 1959 and was the former HMCS TROIS RIVIERES.

Contributors and Credits:

1) Spud Roscoe <spudroscoe(at)eastlink.ca>
2) Frigates of the RCN 1943-1974 by Ken Macpherson
3) MSN Encarta Maps http://encarta.msn.com
4) From America To United States: The History of the Long Range Shipbuilding Program in the USA- Part 4 by L.A. Sawyer and W. H. Mitchell
5) HMS Collingwood Museum ,Chide, Fareham England.
6) Ships of Canada's Naval Forces (1910-1993) by Ken Macpherson and John Burgess.
7) Canadian Coast Guard web site. Vancouver/Quadra extract: http://www.ccg-gcc.gc.ca/usque-ad-mare/chapter08-09_e.htm
8) Vancouver/Quadra statistics http://www.ccg-gcc.gc.ca/usque-ad-mare/details_e.asp?Name=Vancouver
9) Wikipedia http://en.wikipedia.org/wiki/Canadian_Coast_Guard
10) Vancouver photo http://www.ccg-gcc.gc.ca/usque-ad-mare/photos/vancouver2.jpg
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13) Ronald Barrie <BarrieR(at)mar.dfo-mpo.gc.ca>
14) USCG Weather Ships http://www.uscg.mil/history/webcutters/rpdinsmore_oceanstations.html
15) Jack Cain <jccain(at)shaw.ca>
16) Barry Hastings <bhuman(at)shaw.ca>
17) Publication CB 4182/45 Radar Manual (Use of radar) from 1945.
18) Øyvind Garvik <oygarvik(at)online.no>
19) Merve Huges C P Coaster's [cpcoastr@shaw.ca]
20) Miramar Ship Index
21) Alexander (Sandy) McClearn <smcclearn(at)gmail.com>

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