Woolverton in 1935,
Bass Lake, CA
Courtesy W. E. Wohler

RADIO IN THE U.S. NAVY, 1904-1908, ROBERT B. WOOLVERTON

by H. W. Dickow

Colonel Robert B. Woolverton, U.S. Army (ret'd), began his wireless career as an enlisted man in the U.S. Navy in 1904. It was a rewarding experience, as his biography here shows.

When I graduated from high school in 1904, the superintendent of schools in my mid-western town convinced my parents that I was too young to enter college and recommended a four-year enlistment in the Navy. I was interested in electricity and the local Navy recruiting officer told me I could enlist as an Electrician, 3rd Class, go to the Electrical School at the Brooklyn Navy Yard, and then "see the world."

I enlisted with my parents' consent in May, 1904, attended the Electrical School and, as Electrician, 2nd Class, was assigned to the dynamo room of the USS Kentucky in September. The radio room was then being installed on the superstructure deck, and I requested transfer to that capacity, and was assigned there in December. The battleships of the Atlantic Squadron, the "White Squadron," were being equipped with radio for the first time in naval history. They were the Kearsarge (Flagship, 2nd Division), Illinois, Iowa, and Massachusetts. All ships were painted white, with red waterline and spar-colored superstructures. They would have made fine targets in present-day warfare, but they were beautiful, and no man who served in the "White Squadron" can forget the picture they made, steaming in formation in the blue Caribbean, their flags standing out at "Under Way," and taking white seas over their bows.

To me, a boy just out of high school, the radio room was pure magic. The equipment was Slaby-Arco, of German manufacture, and all of it was beautifully designed and made. The receiver was of the "Decohering Coherer" type.

It was quite difficult to make the Morse writer, or printer, operate from the decoherer unless the sending operator was sufficiently skillful to use a very definite rhythm and speed to match the characteristics of the receiver. Consequently we seldom used the Morse writer but listened to the dot and dash chatter of the decohering hammer which tapped against the glass tube of the coherer. This was satisfactory if atmospheric conditions were right, but any static crashes of appreciable strength would not only operate the coherer, but if strong and frequent enough would either make reception impossible or actually damage the coherer by fusing the tiny nickel particles. Again, if another ship anchored nearby were to use his transmitter before we could protect our coherer, the coherer would fuse and be ruined.

My first experience in actually copying a message on this equipment was immediately after my transfer to the radio room. I was on duty alone, when the coherer began making suspicious and unintelligible clatters. I had seen the chief adjust the polarized relay, so I tried the same procedure and to my delight I could make out the call "GK" followed by the call of what turned out to be the torpedo boat Whipple. I answered him and received an OFM (official message) for our skipper. That was my first official message, and was one of the big events of my life.

We had no prescribed operating procedure then, nor at any time during my four-year tour. When calling another ship, we simply sent the called station's call-letters two or three times and signed our own. The called station replied by sending our call two or three times, signed his own, and said "GA" (Go Ahead). The entire operation closely followed land-line procedure, and when we were all through we finished with "30."

When two or more ships were together, we had to be careful of each other's detectors, particularly after electrolytic detectors came into use. For this reason, a ship about to call or answer a station at a distance would throw his antenna-grounding switch to the "ground" position, and then transmit the letter W several times to warn the other ships that full power was about to be used. All of the other ships then opened their antenna switches to protect their detectors.

An amusing incident occurred which will help illustrate how difficult it was to operate the equipment then in our hands. I was in the radio room one day when the chief, named Haney, had the watch. A message came up for transmission, to the Kearsarge, our flag. The chief was a big Irishman, good-natured, but with a huge temper when excited. He was an excellent operator, and no one could have done a better job of sending the message. The flagship asked for a repeat. Haney sent it again, and once more the flag said: PLS REPEAT. This time Haney really chiseled it out, carefully and perfectly. Again the flag operator asked for a repeat. Haney lost his temper, jumped up on the table, held on to the overhead conduits with his hands, and sent the message with his foot! This time the flag said OK.

Soon after this incident, chief Haney was transferred. His relief was a second-cruise man who was a good operator but a poor operator-in-charge. I had heard that a navy operator named Bean had used a miniature light bulb as an electrolytic detector, in conjuction with a pair of low-resistance headphones, with which he was able to get infinitely better reception than any of the coherers would provide. But our new operator-in-charge refused to let me try such a device. At this time, May, 1905, Electrician 1st Class Charles D. Guthrie was transferred from the dynamo room to the radio room. He and I were both eager to try things new, but we could do so only when the Chief was ashore. Fortunately for us he was transferred, and while Guthrie was helping him get his hammock and bag to the gangway, I hooked up the electrolytic detector and had it working when Guthrie came back to the room.

This detector did more to increase our radio range and efficiency than anything that had happened in the Navy. The light bulb was one of those lamps used in the Ardois visual signal devices, and the filament was held by very fine platinum wires brought in through the base. We simply filed away the top of the glass bulb, removed the filament, broke off one of the platinum wires as close as possible to the glass, and bent the other platinum wire over it without touching. This combination was well covered with a 20 per cent solution of either sulphuric or nitric acid, and made an excellent detector. Its greatest feature lay in the fact that we now actually heard the signals themselves, rather than the mere clatter of the coherer.

The signals we heard were rough and harsh, of low frequency, and it was only natural to want a higher, smoother signal note. Consequently I secured the help of a machinist in the engine room who made a new set of interrupter rings for us - first with four segments and finally with as many

as eight. These rings were used in a mercury turbine interrupter which broke the direct current through the primary of the induction coil at about 25 times per second when two rings were used, to several hundred per second with the new eight-ring arrangement. We experimented with these rings through May, June, and July of 1905, and the results were all we had hoped for. In this work I was aided by Guthrie, who was always as eager as I to try anything that might improve operations. Fortunately, Guthrie kept a personal log of our experiments, and in so doing made himself and me the star witnesses in 1914 and 1915 in a famous patent suit involving the three largest wireless companies in the nation. In this suit it was established that the Navy was first to use a high spark frequency in radio communication. It also led to a fine position for Guthrie, and a Fellowship for me in the Institute of Radio Engineers in 1915.

Our first fleet radio officer was Lieutenant John M. Hudgins, who joined us early in 1908. Although stationed on the flagship, he spent much time in our radio room. Once he had the KENTUCKY detached from the fleet, and with him in our wireless shack we cruised around Culebra Island to make observations of signal fading when the Island was between us and the fleet. We also studied directional effects by swinging ship. Hudgins was a fine officer, and his interest and encouragement were an inspiration to all. We were deeply saddened when on the 13th of April, 1906, he was so badly injured in a turret explosion on the Kearsarge that he died a few days later. 1906?

Speaking of turrets, our steel radio shack on the Kentucky was located at the starboard after end of the superstructure deck, with the gun turret so close that we could stick our heads out of our after port holes and touch the eight-inch guns, and spit on the thirteen-inch guns below. We were not required to stand watch while the turret was firing, because it was entirely possible that the entire radio shack might be blown overboard. However, after the turret had been fired several times and the radio shack was still there, the skipper asked us to volunteer to remain on watch to determine whether communication could be maintained while the turret was firing. As all radio operators are a little "touched in the head," Guthrie and I both volunteered. The ship steamed out to the range, and as we approached the target area, the turret swung as far forward as possible to meet the target, the whistle blew, and all four guns let loose. We had bottled both after ports, and locked the steel battle door. The big brass lock on the door was torn off, the after bulkhead bulged in, and the rivets shot across the room like bullets. We felt a terrific concussion. Both of us were stunned, and everything in the room not bolted down was adrift, including the operators! The acid was blown out of the electrolytic detector cup, and except for a pardonable half-minute of "stunned silence" the flagship was unaware of any interruption to our communications. However, I saw to it that the navigating officer got a good look at the inside of our shack after the run, and we never again were asked or required to stand watch there during target practice.

Returning now to the electrolytic detector, we soon made an important improvement by using a piece of Wollaston wire for the upper electrode. This wire was one-ten-thousandths of an inch in diameter, drawn with a silver coating. When adjusted so that it would just touch the acid, the silver was dissolved, leaving a fine platinum whisker for the contact wire. This type of detector was again improved by John Stone, de Forest, Shoemaker, and others by imbedding the platinum whisker in a glass tube, so that only its extreme tip would touch the acid. By this means the sensitivity of the

detector was greatly increased, and it also prevented curling or destruction of the whisker by strong signals. Other improvements followed, such as shaping the glass tube into the form of a fish hook, with the exposed wire tip pointed upward in the acid, so that hydrogen polarization was thereby greatly decreased.

Sometime in 1906, when we had our equipment operating at maximum efficiency, and while we were doing all of the long-distance relay work for the fleet, we learned that the Boston Navy Yard had installed some Stone equipment with a break-in device, which would automatically allow the receiving operator to "break in" while another at a distant point was transmitting. The device operated by opening the antenna circuit to the receiver when the key was closed. We experimented with several such systems but after both Guthrie and I had suffered from severe scalp burns from flashovers, we abandoned our experiments. We then hooked up something that even to this day I marvel at for its simplicity and perfection. Of course, we did not have the ultrasensitive vacuum-tube receivers in those days, but we did work thousands of miles with what we had. The system for breaking-in which we contrived did not in any way disrupt the operation of our electrolytic detector. We merely moved the transmitter inductance to a point near a steel bulkhead so that the ground lead was only an inch or two long. Two insulated dimes were mounted on the end of a 20-ohm sounder, the sounder mounted directly to the bulkhead, and the dime contacts connected in series with the ground lead of the transmitting inductance. The receiver was connected to the upper dime, so that when the sounder was in the "up" position we were receiving through the transmitter inductance. When it was "down" the receiver was grounded. The sounder was operated by contacts added to the rear of the lever of the transmitting key, so adjusted that the sounder closed before the front, or power contacts closed. The lead to the receiver was run on a metal bulkhead to shield it from the transmitter field. In all my long years of radio I have never heard a break-in system function as perfectly as that one did.

After we produced our high spark frequency with the multiple-segment rings, the idea spread quickly throughout the Navy. Then our newest innovation (the break-in system) brought us additional honors. Soon all of the ships of the squadron were similarly equipped. The entire navy looked to us for newer and better ideas and gadgets.

After we had been using our high spark frequency for about a year, we began to hear the new deForest coastal stations using 60-cycle sparks. One outstanding station at Galilee, New Jersey, was using 120 cycles, which sounded much like the buzz of a mosquito. And at about this time, the middle of 1906, the Alabama and Illinois came out of the Brooklyn Navy Yard with the new Fessenden sets. The spark sounded more like a hiss than a tone. Those two ships also used the Fessenden "Liquid Barreter" detector, which in principle was precisely the same as the electrolytic detectors we had made and were then using. As previously stated, the Alabama was the flagship of the 2nd Division, and when the two divisions were separated for maneuvers, the Alabama had to do the long-distance wireless work. As her signals lacked tone, she always had trouble getting through, making it necessary to use all of her available power. As a result, the glass condenser plates would puncture. After one of these maneuvers in the Caribbean Sea, Chief Gallagher of the Alabama told me that he had to use most of the glass panes from the windows of the pilot house to keep his transmitter in operation.

The coastal stations and new ships of the fleet were by this time equipped with AC generators. As we were pretty well fed up with direct-current interrupters, I persuaded my navigating officer to requisition an entire new transmitter of the deForest type, but we received only a Northern Electric motor-generator with starting rheostat and reactance regulator. Thus it was necessary for us to rewind the primary of our old spark coil, then build a new spark gap to handle the increased power, and provide a larger and better condenser. We did all of these things ourselves - and wound up with the best transmitter in the fleet, in spite of the fact that all the new battleships had been coming out of the yards with the latest deForest, Stone, and Fessenden sets, all employing 2-kw transmitters of the latest design.

I believe the excellence of our "home-made" transmitter was due largely to our ability to adjust it, and keep it adjusted for maximum efficiency. On the other hand, the new and modern transmitters on the new ships were equipped with tuning clips soldered in place before they left the Navy Yard. Practically all condensers then in use were of the Leyden Jar type and were not all uniform in individual capacity. Hence, when one or more of these jars became punctured and then replaced, exact resonance was lost. On the Kentucky, while Guthrie and I were aboard, we were able to change our tuning clips each time a new condenser was installed. Thus we were always able to maintain resonance.

I did not like the T-type antennas installed by the Navy Yards because the fanned-out lead-in from the flat top came down fairly close to, and on some ships was supported by, one of the ship's funnels. Almost as soon as I was placed in charge on the Kentucky, I replaced the "T" antenna with one of the "L" type, with the lead-in being a single wire only, brought down into the radio room free and clear of all obstacles. Our antenna was always so "hot" that on a clear night we could go out on deck and not only hear the rippling hiss of the antenna while sending, but we could actually see the four wires of the flat-top portion of the antenna glow.

Our navigating officer joined our efforts whole-heartedly and always provided us with the necessary cash to purchase ashore any special equipment needed for our experiments. Guthrie and I were both excused from participating in any ship's drills. When the junior officers learned that I would soon take the entrance examinations for Harvard, they tutored me in various subjects, particularly mathematics, during the entire last year of my tour on the Kentucky. We were proud of our relations with our officers. I was particularly happy when, on the last day of my service on the Kentucky, I was summoned to the flagship Maine, and led to the quarterdeck, where Admiral Robley D. Evans said some very kind things to me, then said goodbye, and later sent me a letter of commendation for presentation to the Dean of Harvard.

When I was about to leave the Kentucky for the last time, my navigating officer presented me with a box of ten of the Slaby-Arco coherers which came with the original installation in 1904, and I still have several of these in my possession as precious reminders of my happy experiences in those first days of radio in the United States Navy.

By late Fall of 1907, Guthrie and I were both getting to be "short-timers." I had been promoted to the rating of permanent Chief in 1907, and Guthrie was due for a similar appointment. He was sent to Philadelphia to put the

new Navy Yard station there in commission, and I was transferred to San Juan, Puerto Rico.

The San Juan station was part of a network which included Guantanamo, Colon, and Key West. The transmitters were made by deForest; 60-cycle, 35-kw outfits of the spark type, the highest powered sets in the Navy. The spark gap was enclosed in a heavy wooden box, and even when tightly closed the sound of the spark could be heard clear off the reservation. When the box was opened, the spark could be heard a mile away in San Juan. The primary power for the transformer had to be keyed with a large solenoid whose contacts were one-inch in diameter, immersed in oil. One contact was made of steel, the other of brass. Frequently these contacts "froze" when operated by the hand key, making it necessary for us to pry them apart with a stick. We actually used this stick as a substitute for a telegraph key at times, and we were able to send as fast as twelve words per minute, which was actually the maximum speed at which the transmitter proper could be operated. Only Key West could send faster, yet his speed never reached twenty words per minute, and the tone of his spark was not up to par.

When I took charge at San Juan in 1907, no signals from Colon had ever been heard there, and Key West was received only on rare occasion. All traffic had to be relayed via Guantanamo. I busied myself with the receiving equipment, duplicating what we had done on the Kentucky, and soon we were able to communicate directly with Colon and Key West.

A lot of interesting events occurred while I was at San Juan. One morning before dawn, one of our operators was working Key West. The rest of us were asleep in the same building when we were awakened by dense smoke and the sound of crackling flames. When we dashed into the operating room, the sending operator was wholly unaware of the fire, nor could he hear the crackling of the flames because of the racket made by his spark gap. The insulation on one of the high-voltage leads had broken down and had set fire to the oil-soaked wooden floor. The fire caused one of the big crockery condenser "bath tubs" to crack, with the result that much of the condenser oil leaked to the floor. Soon the fire spread through the transmitter room and under the floor. Fortunately it was a Saturday morning, and only the day previously we had connected-up all of the fire hoses for the customary Saturday fire drill in the Navy Yard. We managed to save the building, but it was a shambles for weeks later until we repaired the "bath tub" condensers. They consisted of large glass plates covered on both sides with tin foil. Many of these were punctured and broken.

Static was terrific at all times. We never dared touch our big antenna unless it was well grounded, as otherwise it would literally tear our pants off.

We had a telegraph circuit that was interesting. It connected us with the San Juan office of the Insular Telegraph Service for accepting and delivering commercial ship traffic, for we were the only radio station on the island. It was a loop circuit which ran completely around the island, and we were but one of many stations on this loop. There was so much leakage on this circuit that we never knew when any other station was calling us unless the San Juan city office first notified us. Then we would have to adjust our main line relay until it responded to the calling station. Each station on the loop had its own main line battery, and each operator had to adjust his relay constantly to know whether he was being called or not.

Life at old "SA" in 1907 was a tough assignment, but it had its compensations. We had a fine bunch of operators, and the best mess on the island. We had many friends. We all had motorcycles. On Sundays, we exchanged visits with the plantation owners who kept us well supplied with the pick of the best tropical fruits I have ever eaten.

All of my four years in the Navy were happy, interesting, and instructive. They proved most helpful to me, both during my engineering course in college and throughout my after-life in radio work. It is interesting to note that practically every Navy radio operator whom I knew and worked with in those first days of radio in this country has become prominent in some branch of the science ever since.

For the information of old-timers who may have lost the record, and for other Navy men who may be interested, I append the following list of U.S. Navy Shore Radio Stations on the Atlantic Coast and in the Caribbean area, together with their call-letters as of 1904-1908:

PORTLAND, ME	"PA"
PORTSMOUTH, NH	"PC"
BOSTON NAVY YARD	"PG"
CAPE COD, MASS	"PH"
NEWPORT, RI	"PK"
NANTUCKET LIGHTSHIP	"PI"
MONTAUK POINT	"PR"
BROOKLYN NAVY YARD	"PT"
HIGHLANDS OF NAVESINK	"PV"
CAPE HENLOPEN	"PX"
ANNAPOLIS, MD	"QG"
WASHINGTON, DC	"QI"
NORFOLK NAVY YARD	"QL"
CAPE HENRY	"QN"
DIAMOND SHOAL LIGHTSHIP	"QP"
BEAUFORT, NC	"QS"
CHARLESTON, SC	"QU"
CHARLESTON LIGHTSHIP	"QV"
ST. AUGUSTINE, FL	"QX"
PENSAVOLA, FL	"RK"
NEW ORLEANS, LA	"RO"
JUPITER INLET, FL	"RA"
KEY WEST, FL	"RD"
DRY TORTUGAS	"RF"
GUANTANAMO	"SI"
SAN JUAN, PR	"SA"
CUIEBRA, VI	"SD"
COLON, RP	"SL"

Prominent commercial coastal stations of the United Wireless Telegraph Company, as of 1907-1908, who handled personal messages as a courtesy for Navy ships in the Atlantic were the following: No. 42 Broadway, New York City "NY"; Bridgeport, Connecticut "BG"; Galilee, N.J. "G"; Atlantic City, NJ "AX"; Cape Hatteras, NC "HA".

Call-letters beginning with the letter P were later transferred to commercial wireless shore stations along the Pacific Coast, while the stations of the US Navy in this same area were given call-letters beginning with

the letter T. Still later, when three-letter calls were assigned, the Navy stations of the Pacific were given NP as the first two letters, while on the Atlantic the first two letters were NA, thus making it easy to distinguish between the two coastal regions.

Upon graduation from Harvard in 1912, I joined the National Electric Signaling Company of Brooklyn as Research Engineer. My work with this company was devoted exclusively to the development of the Fessenden heterodyne for reception, using the Chaffee arc as a generator.

From 1913 to 1916, I was Pacific Coast Radio Inspector for the Department of Commerce with headquarters at San Francisco. The famous Ship Act of August 13, 1912, designed to promote the safety of life at sea, had just gone into effect, and it was during this period that occurred the long drawn out strike of the Radio Operators Union.

From 1916 to the Spring of 1918, I was Radio and Electrical Engineer with the Federal Telegraph Company at San Francisco, in which position I first assisted in the design of the high powered arc transmitters for the US Navy, and then installed the 250-kw station at San Diego, and the 500-kw stations at Pearl Harbor, Hawaii, and Cavite, P.I.

Upon my return from Cavite in the Spring of 1918, I offered my services to the Army and was commissioned a Captain in the Signal Corps, O.R.C., and after a short period of duty in the office of the Chief Signal Officer in Washington, proceeded overseas in August and was at once assigned as Army Radio Officer, Second American Army, with headquarters at Toul, France, and continued in that capacity until the Armistice.

Returning to the United States in May, 1919, I served as Pacific Coast Radio Supervisor for the United States Shipping Board until July, 1920, when I returned to the Signal Corps as radio engineer in the office of the Chief Signal Officer. It was while in this position that Washington founded the Army Radio Net, later known as the War Department Radio Net, connecting the War Department with the nine Corps Area headquarters of the United States. In November, 1920, I accepted a commission in the Regular Army as Captain, Signal Corps, and became Officer-in-Charge of all Army radio stations, ashore and afloat. In 1927 I became Officer-in-Charge, Second Section, Alaska Communication System, with headquarters at Seward, Alaska.

Returning from Alaska in 1929, I was assigned as Radio Officer, Ninth Corps Area, with headquarters at the Presidio of San Francisco, and remained on this assignment until July, 1935, when I was transferred to Omaha as Executive Officer, Signal Office, Seventh Corps Area.

In July 1938, I was again assigned to the Alaska Communication System. In September, 1938 I was promoted to Major, and on June 12, 1941, to Lieut. Colonel, and became officer-in-charge of the Alaska system during its tremendous expansion under the emergency.

On October 17, 1941, I was transferred to Hawaii and was assigned as Department Radio Officer with headquarters at Fort Shafter, Oahu.

In January, 1943, I was ordered to South America where I was assigned as Theater Signal Officer, South Atlantic Theater, with headquarters at

Recife, Brazil. During this assignment I was promoted to Colonel on June 16, 1943. By the beginning of 1944, my health began to fail because of too long continued tropical service, and in February of that year I was ordered to a general hospital in the United States where a Retirement Board recommended my retirement for physical disability. I was retired on September 30, 1944.*

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*Colonel Woolverton died in San Francisco on September 1, 1962, an avid operator of his ultra-modern amateur radio station W6WN to the last. He maintained that his most interesting experience was on the day he put away his coherer and for the first time actually heard signals using an electrolytic detector improvised from a miniature lamp built in 1904, as was stated earlier.

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Story from unpublished book "TALES OF THE WIRELESS PIONEERS" (BOOK 2 - Telegraphers & others I have known) by the late Henry W. Dickow, Honorary Member #1 and Member 3-SSGP. Mr. Dickow donated his publications to Bill Breniman before becoming a silent key on April 17, 1971. The 'Ancient Mariner' is publishing them for enjoyment of Society members.